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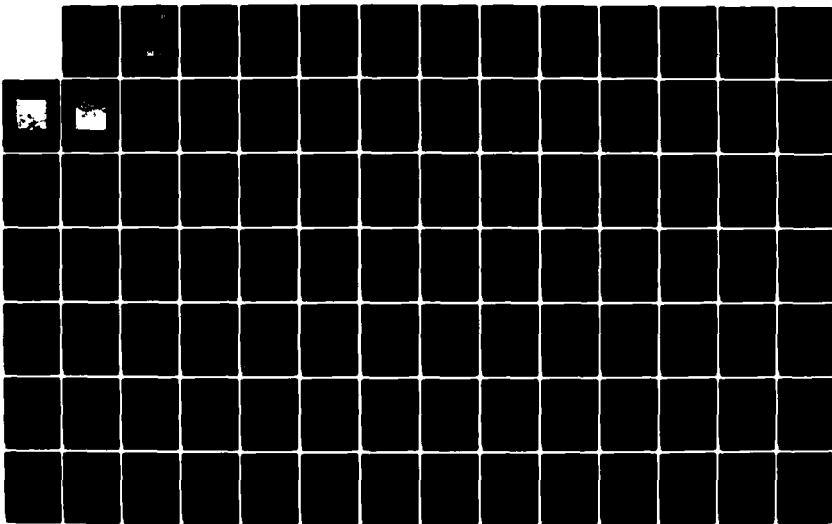
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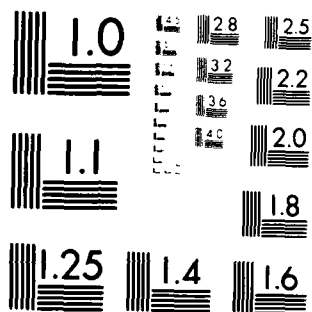
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CONNECTICUT RIVER BASIN
AMHERST, MASSACHUSETTS

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FACTORY HOLLOW DAM
MA 00063

FACTORY HOLLOW DIKE
MA 00597

**PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM**

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

OCTOBER 1980

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
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	6. PERFORMING ORG. REPORT NUMBER	
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION	8. CONTRACT OR GRANT NUMBER(s)	
9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS	
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, Connecticut River Basin Amherst, Massachusetts		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Factory Hollow Dam is a 110 foot long stone masonry dam. The maximum height of the dam is 32.5 feet. It is a 140 foot long earthfill embankment dike. The dam has been classified in the small size and high hazard categories and the dike in the small size and significant hazard categories. A test flood equal to 1/2 the PMF was used to evaluate the capacity of the spillway. Generally the dam and dike are in fair condition.		



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:

NEDED

MAR 17 1981

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

Dear Governor King:

Inclosed is a copy of the Factory Hollow Dam (MA-00063) and Factory Hollow Dike (MA-00597) Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts. In addition, a copy of the report has also been furnished the owner, Conservation Commission of the Town of Amherst, Amherst, MA..

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Quality Engineering for your cooperation in carrying out this program.

Sincerely,

C. E. EDGAR, III
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

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FACTORY HOLLOW DAM

MA 00063

FACTORY HOLLOW DIKE

MA 00597

CONNECTICUT RIVER BASIN
AMHERST, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION
PROGRAM

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

BRIEF ASSESSMENT

Identification No.: MA00063 - Factory Hollow Dam
MA00597 - Factory Hollow Dike

Town: Amherst

County and State: Hampshire County, Massachusetts

Stream: Mill River, tributary of the Connecticut River

Date of Inspection: August 19, 1980

Factory Hollow Dam is a 110-foot long stone masonry dam built in 1895. The dam which has a maximum height of 32.5 feet is the spillway. The top of the dam varies between Elevation (El) 223 and 224.7 (National Geodetic Vertical Datum of 1929). The pond is presently used for recreational purposes.

There are a total of three outlets at the dam. The low level outlet is a 16-inch diameter cast iron pipe with an invert at El 195. A gate valve to control flow through this outlet is located in a manhole on the upstream side of the dam. However, there is no valve stem to operate the gate valve and the manhole is submerged under approximately 9 feet of water when the pond is at El 223. There are also two upper level outlets near the right abutment. The first is a 36-inch diameter penstock with a downstream invert at El 208.5. The second outlet is a 3-foot square stone box sluiceway with a downstream invert at El 210. Steel plates in slide frames under 6 feet of water are located on the upstream side of each of these outlets. There are no mechanisms to operate the plates. A crane would be required to operate the upper level outlets. The crane would have to be located in the streambed downstream of the dam. During the test flood, due to the discharge over the spillway, this would not be possible resulting in all of the outlets being inoperable. The opening of these outlets are required to lower the pond for access to the low level outlet manhole.

Factory Hollow Dike is a 140-foot long earthfill embankment located 135 feet northwest of the dam and is separated from the dam by a rock outcrop. The dike has a maximum height of 3 feet and the top is at El 230. There is no spillway or outlet at the dike; the pond level is controlled at Factory Hollow Dam.

There are deficiencies which must be corrected to assure the continued performance of this dam and dike. This conclusion is based on the visual inspection of the site and a review of the available data. Generally the dam and dike are in fair condition.

The following deficiencies were observed at Factory Hollow Dam: inaccessible and inoperable outlets; seepage at the base of the dam and along both abutments; leakage through the low level outlet and penstock; mortar missing from the stone masonry on top of the dam at right abutment; and a lack of erosion control at the toe of the dam to prevent the falling water from washing out the toe area.

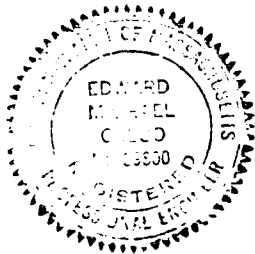
The following deficiencies were observed at the Factory Hollow Dike: trees and brush growing on the upstream face of the dike; no erosion protection on the upstream face; and minor erosion of the upstream face of the embankment.

Based on Corps of Engineers' guidelines, the dam has been classified in the small size and high hazard categories and the dike in the small size and significant hazard categories. A test flood equal to one half the probable maximum flood (PMF) was used to evaluate the capacity of the spillway. The test flood outflow is 8,920 cfs, resulting in a pond level at El 231.3. The test flood would produce a depth of flow of 8.3 feet over the dam (spillway) and overtop the dike by 1.3 feet. Hydraulic analyses indicate that the spillway (dam) can discharge 3,670 cfs, or 41 percent of the test flood outflow before a low area 140 feet east of the left dam abutment is overtopped. The spillway can discharge 6,020 cfs, or 67 percent of the test flood outflow before the dike is overtopped.

It is recommended that the Owner employ a qualified registered professional engineer to conduct an investigation of the seepage noted at the base and abutments of the dam; design controls for the operation of the lower and upper level outlets; design erosion protection for the toe of the dam; and evaluate the need to complete the concrete slab on the upstream face of the dam. In addition, the Owner should repair the deficiencies listed above, as described in Section 7.3. The Owner should also implement a program of annual technical inspections, a plan for surveillance of the dam and dike during and after periods of heavy rainfall, and a plan for notifying downstream residents in the event of an emergency at the dam or dike.

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

The measures outlined above and in Section 7 should be implemented by the Owner within a period of 1 year after receipt of this Phase I Inspection Report.



A handwritten signature of Edward M. Greco in cursive script.

Edward M. Greco, P.E.
Project Manager
Metcalf & Eddy, Inc.

Massachusetts Registration
No. 29800

Approved by:

A handwritten signature of Stephen L. Bishop in cursive script.

Stephen L. Bishop, P.E.
Vice President
Metcalf & Eddy, Inc.

Massachusetts Registration
No. 19703



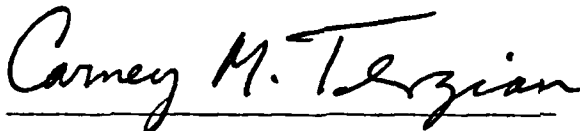
FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

Factory Hollow Dam (MA-00063)

This Phase I Inspection Report on and Factory Hollow Dike (MA-00597) has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.



ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

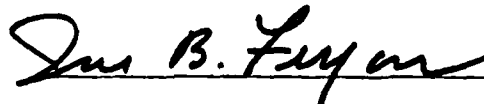


CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division



JOSEPH W. FINEGAN, JR., CHAIRMAN
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:



JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in Recommended Guidelines for Safety Inspection of Dams, for a Phase I Investigation. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions will be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general conditions and the downstream damage potential.

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

TABLE OF CONTENTS

	<u>Page</u>
BRIEF ASSESSMENT	1
PREFACE	v
OVERVIEW PHOTO	ix
LOCATION MAP	x
REPORT	
SECTION 1 - PROJECT INFORMATION	1
1.1 General	1
1.2 Description of Project	1
1.3 Pertinent Data	5
SECTION 2 - ENGINEERING DATA	11
2.1 General	11
2.2 Construction Records	11
2.3 Operating Records	11
2.4 Evaluation	12
SECTION 3 - VISUAL INSPECTION	13
3.1 Findings	13
3.2 Evaluation	15
SECTION 4 - OPERATING AND MAINTENANCE PROCEDURES	16
4.1 Operating Procedures	16
4.2 Maintenance Procedures	16
4.3 Evaluation	16
SECTION 5 - EVALUATION OF HYDRAULIC/ HYDROLOGIC FEATURES	17
5.1 General	17
5.2 Design Data	17
5.3 Experience Data	17
5.4 Test Flood Analysis	17
5.5 Dam Failure Analysis	18

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

TABLE OF CONTENTS (Continued)

	<u>Page</u>
SECTION 6 - STRUCTURAL STABILITY	20
6.1 Visual Observations	20
6.2 Design and Construction Data	20
6.3 Post Construction Changes	20
6.4 Seismic Stability	20
SECTION 7 - ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES	21
7.1 Dam Assessment	21
7.2 Recommendations	22
7.3 Remedial Measures	22
7.4 Alternatives	23

APPENDIXES

APPENDIX A - PERIODIC INSPECTION CHECKLIST	
APPENDIX B - PLANS OF DAM AND PREVIOUS INSPECTION REPORTS	
APPENDIX C - PHOTOGRAPHS	
APPENDIX D - HYDROLOGIC AND HYDRAULIC COMPUTATIONS	
APPENDIX E - INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS	

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

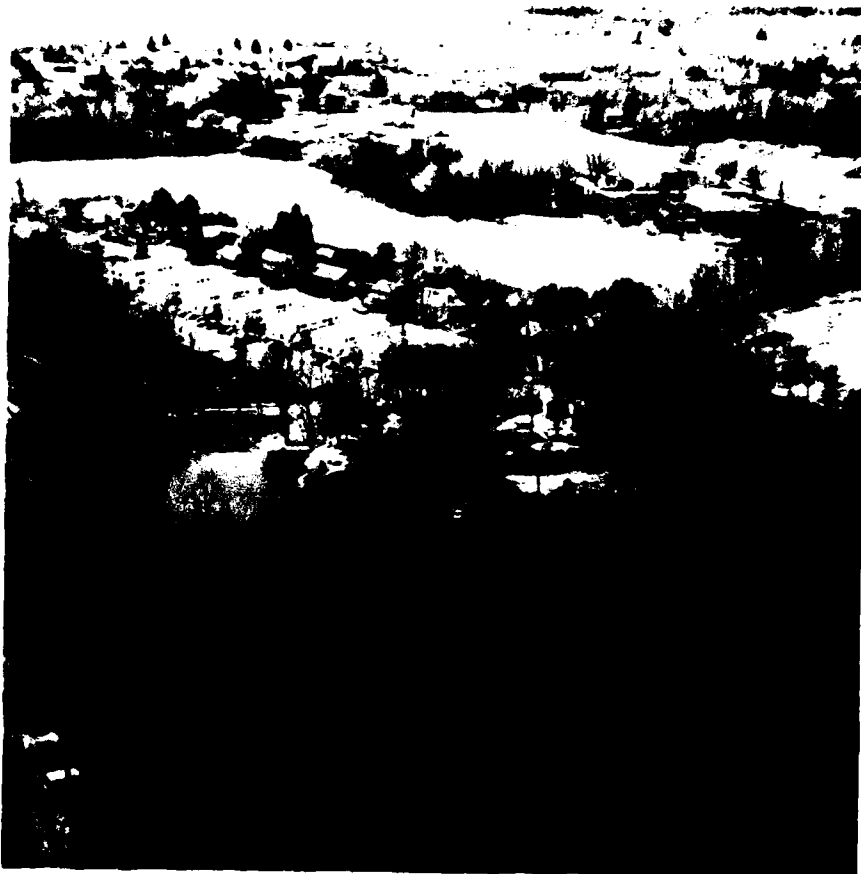
OVERVIEW
FACTORY HOLLOW DAM & DIKE
AMHERST, MASSACHUSETTS

FACTORY
HOLLOW
DIKE
MA 00597



FACTORY
HOLLOW
DAM
MA 00063

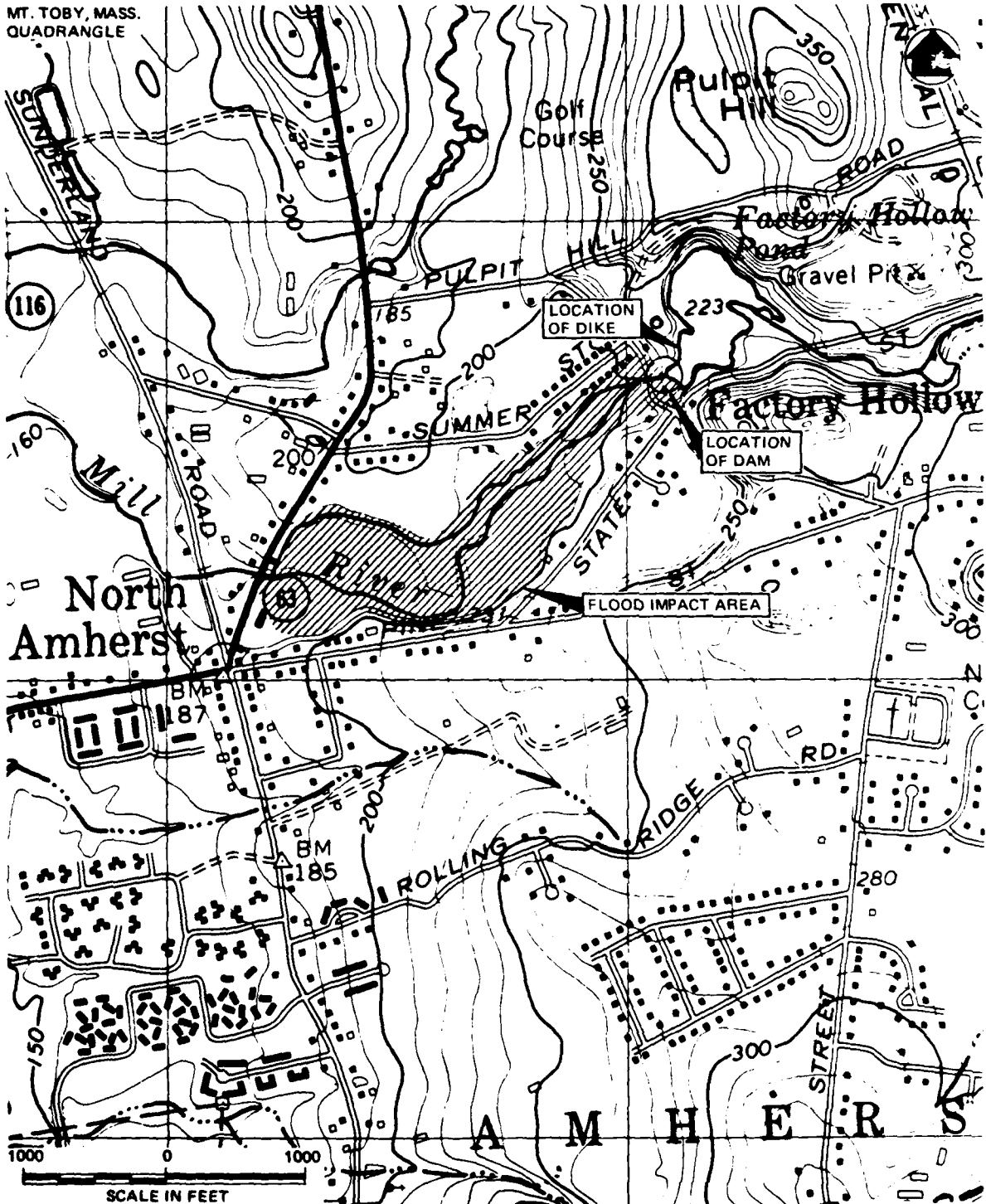
DOWNSTREAM OVERVIEW
FACTORY HOLLOW DAM & DIKE
AMHERST, MASSACHUSETTS



FACTORY
HOLLOW
DAM

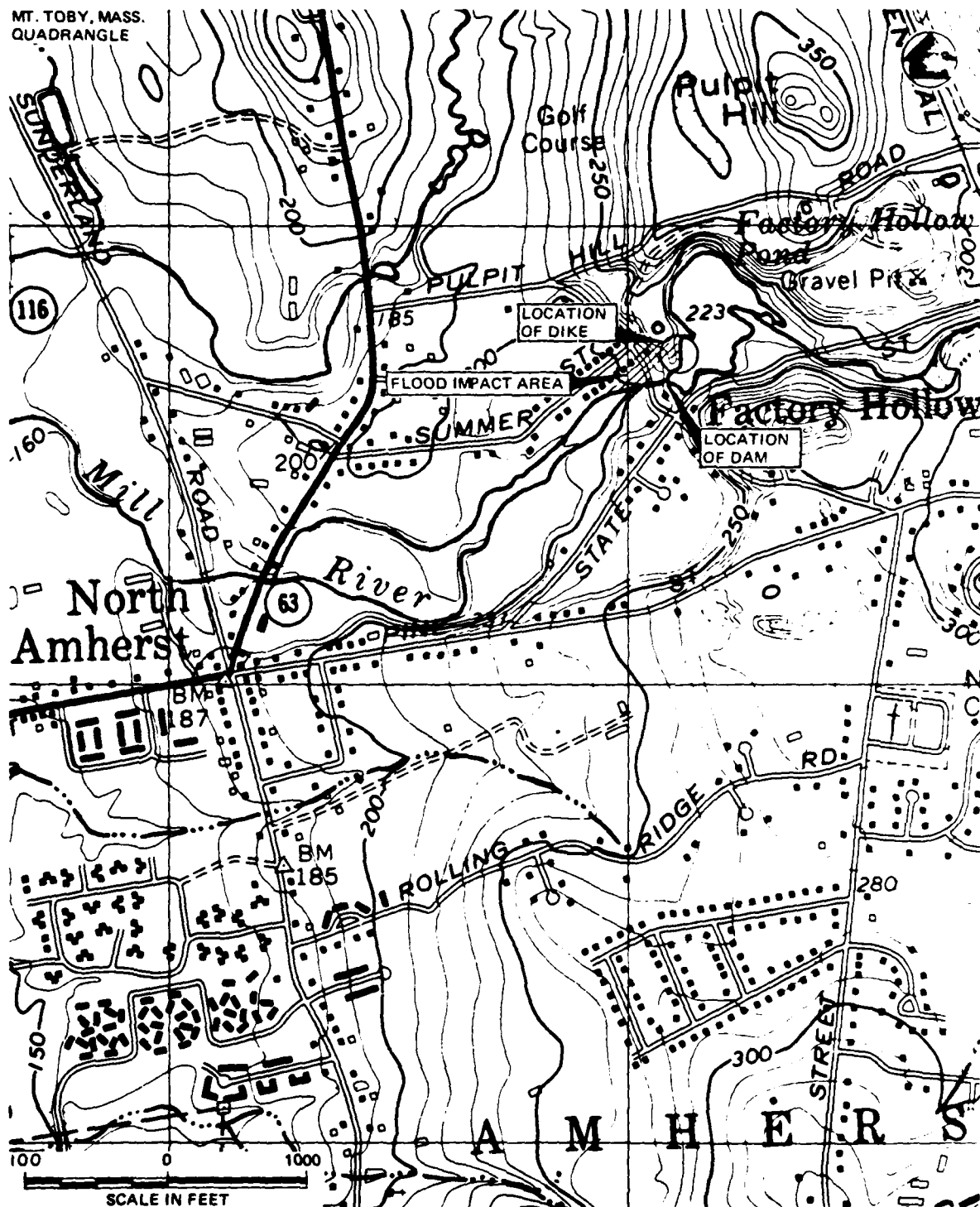
FACTORY
HOLLOW
DIKE

MT. TOBY, MASS.
QUADRANGLE



LOCATION MAP - FACTORY HOLLOW DAM

MT. TOBY, MASS.
QUADRANGLE



LOCATION MAP - FACTORY HOLLOW DIKE

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

SECTION 1

PROJECT INFORMATION

1.1 General

- a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Metcalf & Eddy, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Contract No. DACW 33-80-C-0054, dated April 18, 1980, has been assigned by the Corps of Engineers for this work.
- b. Purpose
 - (1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.
 - (2) Encourage and assist the States to quickly initiate effective dam safety programs for non-Federal dams.
 - (3) Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

- a. Location. The dam and dike are located on Mill River about 6.3 miles upstream of the confluence with the Connecticut River, in the Connecticut River Basin. The dam and dike are in the Town of Amherst, Hampshire County, Massachusetts (see Location Map). The coordinates of Factory Hollow Dam are Latitude 42 deg. 24.9 min. north

and Longitude 72 deg. 31.2 min. west. The coordinates of Factory Hollow Dike are Latitude 42 deg. 25 min. north and Longitude 72 deg. 31.1 min. west.

- b. Description of Dam and Appurtenances. Factory Hollow Dam is a 110-foot long, stone masonry dam with a maximum height of 32.5 feet (see Plan of Dam and Sections in Appendix B and photographs in Appendix C). The top of the dam varies between 4 and 6.5 feet wide and from El 223 to 224.7. The dam is the spillway. The upstream face is a 1:1 (horizontal to vertical) slope partially covered with an 8-inch thick reinforced concrete slab. The concrete slab covers approximately 60% of the dam length (see pg B-45). The downstream face is a vertical stone masonry wall with open joints. The as-built drawings from repairs made in 1976 show that the dam is founded on rubble and timber ties (see Figure B-4).

The stream below the dam is 50 feet wide. The side slopes are 5 feet high for a distance of 125 feet downstream. The floor of the stream is the natural streambed and slopes at 2.5 percent.

The low-level outlet for the dam is a 16-inch diameter ductile iron pipe. The invert at the downstream end of the outlet is at El 195. Flow into the outlet is controlled by a gate valve located within a manhole on the upstream side of the dam within the pond. At normal pool, the manhole is submerged under 9 feet of water. The two upper-level outlets for the dam are a 36-inch diameter pipe (penstock) and a 3 foot square stone sluiceway. The invert of the penstock is at El 208.5. The invert of the sluiceway is at El 210. Flow from these outlets is controlled by steel plates set in slide frames. The plates have hooks to which cables can be attached for removal. At normal pool (El 223), the top of these plates are under 6 feet of water.

Factory Hollow Dike is located approximately 140 feet northwest of Factory Hollow Dam and is separated from the dam by a rock outcrop. It is a 140 foot long, earthfill embankment with a maximum height of 3 feet. (see plans of dike and sections in Appendix B and Photographs in Appendix C). The top of the dike is 10 feet wide and is at El 230. The dike is founded upon natural ground in a low area between bedrock outcropping to the west of the right abutment of Factory Hollow Dam and high ground at the dike's right abutment.

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

The upstream face is a 1:1 (horizontal to vertical) slope covered with brush and several large diameter trees. The downstream face is a 1:1 slope covered with grass.

The Factory Hollow Dike has no outlets or controls. The pond level is controlled at Factory Hollow Dam.

- c. Size Classification. Factory Hollow Dam has a maximum height of 32.5 feet and a maximum storage capacity of 80 acre-feet.

Factory Hollow Dike has a maximum height of 3 feet and a maximum storage capacity of 24 acre-feet between the top of the dike (El 230) and the toe of the dike (El 227).

The dam is therefore classified in the small size category which corresponds to a height of 25 to 40 feet or a storage capacity of 50 to 1,000 acre-feet. For the purposes of this report the dike has also been classified in the small size category even though the height and storage capacities do not meet the minimum requirements.

- d. Hazard Classification

Factory Hollow Dam

There are 6 apartment houses and 3 residential dwellings located along the stream 220 feet downstream of the dam (see Flood Impact Area shown on the Location Map). The foundations of these structures are approximately 8 feet above the bottom of the stream. An assumed failure of the dam with the water surface at El 228.4 would result in a flood wave 14 feet high 220 feet downstream of the dam as compared to a depth of flow of 9 feet before failure. Prior to failure, the discharge over the dam will not cause flooding in the parking lot or in the area adjacent to the apartments. However, subsequent to failure the height of the flood wave will be 5 feet causing a significant amount of damage and possible loss of more than a few lives. Accordingly, the dam has been placed in the "high" hazard category.

Factory Hollow Dike

There is one house located approximately 100 feet downstream of Factory Hollow Dike. A failure of the Factory Hollow Dike would cause a flood flow of about 2 feet at the house and appreciable damage could occur. Flooding would also occur in the parking lot at the apartments further downstream.

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

Accordingly, the dike has been placed in the "significant" hazard category.

- e. Ownership. Factory Hollow Dam is owned by the Conservation Commission of the Town of Amherst, Town Office, Amherst, Massachusetts 01002. Mr. Donald Jacobs, Assistant Town Manager (telephone 413-253-2557) granted permission to enter the property and inspect the dam.

Factory Hollow Dike is located on property owned by Mr. George A. Cavanaugh, Jr., 64 Mill Street, Amherst, Massachusetts 01002 (telephone 413-549-0611).

- f. Operator. The dam is operated by personnel from the Town of Amherst. There is no operator for the dike.
- g. Purpose of the Dam. The water in Factory Hollow Pond is currently used for recreation by the Town of Amherst. A sand and gravel plant also draws water from the pond for washing. The original purpose of the dam was to supply water for mills.
- h. Design and Construction. Construction of the existing Factory Hollow Dam was completed in 1895. No drawings or specifications are available on the original construction. In 1976, the dam was partially repaired and as-built drawings were prepared by the Town of Amherst Engineering Office. The drawings show that the repaired dam is essentially as it appears today, except that the downstream end of the penstock is a 36-inch diameter pipe and the stone sluiceway is 3 feet square as compared to a 45-inch diameter penstock pipe and a 2.5 foot by 3.25 foot sluiceway as shown on the drawings.

Previous inspection reports indicate that since construction, the dam has been in poor condition. Repairs have been made such as partially covering the upstream face with an 8 inch thick reinforced concrete slab; installing a 16-inch diameter low level outlet pipe; constructing a manhole for the gate valve on the low level outlet; and installing steel plates at the upstream ends of the penstock and sluiceway.

There are no drawings, specifications, or construction records available for Factory Hollow Dike. The date of construction is unknown. Previous inspection reports indicate the dike has been in good condition.

- i. Normal Operating Procedures. There are no operating procedures for Factory Hollow Dam or Factory Hollow Dike.

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

The low-level outlet was last operated in 1976 when it was installed. Factory Hollow Dike has no outlets.

1.3 Pertinent Data

- a. Drainage Area. The drainage area is approximately 9,600 acres (15 square mile) and consists of gently rolling land (see Figure D-1 in Appendix). The watershed ranges from El 1300 to El 223. The drainage area includes drainage from Leverett Pond and Roaring, Cushman and Doolittle Brooks. About 3.7 percent of the drainage area is ponds and swamps. In general, the undeveloped portions of the drainage area consist of 90 percent woodland, and 10 percent open fields. Light, residential and commercial development occurs in the area.
- b. Discharge. Discharge from Factory Hollow Dam flows over the spillway (dam) and into an unlined stream. Water also discharges from the outlets into the discharge channel.

(1) Outlets:

Low Level - 16-inch diameter pipe
Invert - El 195
Discharge capacity at El 223
(top of dam) - 100 cfs

Upper Level - Penstock
36-inch diameter pipe
Invert - El 208.5
Discharge capacity at El 223
(top of dam) - 100 cfs

- Sluiceway
3 foot square opening
Invert - El 210
Discharge capacity at El 223
(top of dam) - 144 cfs

- (2) Maximum known flood at damsite: unknown
- (3) Ungated spillway capacity at top of dike: 6020 cfs at El 230.
Ungated spillway capacity at low area east of dam: 3,670 cfs at El 228.4.
- (4) Ungated spillway capacity at test flood elevation: 7543 cfs at El 231.3.

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

- (5) Gated spillway capacity at normal pool elevation:
N/A.
- (6) Gated spillway capacity at test flood elevation:
N/A.
- (7) Total spillway capacity at test flood elevation:
7,543 cfs at El 231.3
- (8) Total project discharge at top of low area east of
dam. 3,670 cfs at El 228.4
- (9) Total project discharge at test flood elevation:
8920 cfs at El 231.3.

Factory Hollow Dike has no spillway or outlets.

- c. Elevation (feet above National Geodetic Vertical Datum of 1929 (NGVD)). A benchmark was established at El 223 on crest of the Factory Hollow Dam spillway. This elevation was estimated from a United States Geological Survey (U.S.G.S.) topographic map.

Factory Hollow Dam

- (1) Streambed at toe of dam: 192.2
- (2) Bottom of cutoff: N/A
- (3) Maximum Tailwater: unknown
- (4) Normal pool: 223
- (5) Full flood control pool: N/A
- (6) Spillway crest: 223
- (7) Design surcharge (original design): unknown
- (8) Top of dam: 223 to 224.7
- (9) Test flood surcharge: 231.3

Factory Hollow Dike

- (1) Streambed at toe of dike: 227
- (2) Bottom of cutoff: N/A
- (3) Maximum tailwater: N/A

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

- (4) Normal pool: N/A
- (5) Full flood control pool: N/A
- (6) Spillway crest (gated): N/A
- (7) Design surcharge (original design): unknown
- (8) Top of dike: 230
- (9) Test flood surcharge: 231.3

d. Reservoir (Length in feet)

- (1) Normal pool: 1,000
- (2) Flood control pool: N/A
- (3) Spillway crest pool: 1,000
- (4) Top of dam: 1,000
- (5) Test flood pool: 1,000

e. Storage (acre-feet)

Factory Hollow Dam

- (1) Normal pool: 80
- (2) Flood control pool: N/A
- (3) Spillway crest pool: 80
- (4) Top of dam: 80
- (5) Test flood pool: 147

Factory Hollow Dike

- (1) Normal pool: N/A
- (2) Flood control pool: N/A
- (3) Spillway crest pool: N/A
- (4) Top of dike: 24
- (5) Test flood pool: 33

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

f. Reservoir surface (acres)

- (1) Normal pool: 8
- (2) Flood-control pool: N/A
- (3) Spillway crest: 8
- *(4) Test flood pool: 8
- *(5) Top of dam: 8

g. Dam

Factory Hollow Dam

- (1) Type: stone masonry
- (2) Length: 110 feet
- (3) Height: 32.5 feet
- (4) Top width: varies between 4 and 6.5 feet
- (5) Side slopes: U/S 1V:1H
D/S vertical
- (6) Zoning: unknown
- (7) Impervious core: none
- (8) Cutoff: none
- (9) Grout curtain: none
- (10) Other: N/A

Factory Hollow Dike

- (1) Type: earth
- (2) Length: 140 feet
- (3) Height: 3 feet

*Based on the assumption that the surface area will not significantly increase with changes in pool elevation from 223 to 231.3

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

- (4) Top width: 10 feet
- (5) Side slopes: 1V:1H
- (6) Zoning: unknown
- (7) Impervious core: unknown
- (8) Cutoff: unknown
- (9) Grout curtain: unknown
- (10) Other: N/A

h. Diversion and Regulating Tunnel: N/A

i. Spillway

Factory Hollow Dam

- (1) Type: Broad crested weir
- (2) Length of weir: 110 feet (entire length of dam acts as spillway)
- (3) Crest elevation: 223
- (4) Gates: None
- (5) Upstream channel: Concrete face on dam
- (6) Downstream channel: Natural streambed
- (7) General: None

Factory Hollow Dike has no spillway.

j. Regulating Outlets

Factory Hollow Dam

- (1) Invert El: 195
- (2) Size: 16-inch diameter
- (3) Description: Ductile-iron pipe

(4) Control mechanism: On upstream face of dam - Manhole, under 9 feet of water when pond is at normal pool, controls access to gate valve. Gate valve opened by a control stem. The Town of Amherst has no control stem for this gate valve (see pg B-4). Therefore, it is considered to be inoperable at this time.

(5) Other:

Penstock - 36-inch diameter iron pipe invert at El 208.5 on downstream end. Control mechanism - steel plate installed in slide frame on upstream end. Hook on plate allows for cable to be attached for removal - under 6 feet of water. No controls visible at top of dam.

Sluiceway - 3-foot square stone opening through dam. Invert elevation at downstream end at El 210. Control mechanism - steel plate installed on slide frame on upstream end. Hook on plate allows for cable to be attached for removal. No controls visible at top of dam. Under 6 feet of water at normal level.

A crane would be required to operate the penstock and sluiceway. The crane would have to be located in the streambed downstream of the dam. During the test flood, due to the discharge over the spillway, this would not be possible resulting in all of the outlets being inoperable. The opening of these outlets is required to lower the pond for access to the low level outlet manhole.

Factory Hollow Dike

No regulating outlets.

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

SECTION 2
ENGINEERING DATA

2.1 General.

Factory Hollow Dam. The engineering data available for this Phase I inspection includes drawings dated March 1977 (as-builts for 1976 repairs) prepared by the Town of Amherst and computations dated January, 1975 prepared by Tighe & Bond Consulting Engineers, Holyoke, Massachusetts. The drawings were obtained from the Town of Amherst Engineer's Office (see Figures B-3 and 4). There are no other drawings, specifications, or computations available from the Owner, State, or County agencies. Copies of previous inspection reports dated 1968 to 1976, prepared by Tighe and Bond Consulting Engineers and the Massachusetts Department of Public Works are included in Appendix B. The most recent inspection was conducted in 1976 by Massachusetts Department of Public Works. A copy of that report is given in Appendix B.

Factory Hollow Dike. There were no engineering data available for review during this Phase I inspection.

Copies of previous inspection reports dated 1972, 1975 and 1976 prepared by the Massachusetts Department of Public Works are included in Appendix B.

We acknowledge the assistance and cooperation of personnel from the Massachusetts Department of Environmental Quality Engineering, Division of Waterways; the Massachusetts Department of Public Works; and the Hampshire County Engineers Office. In addition, we acknowledge the assistance of Mr. James A. Smith, of the Town of Amherst, who provided information on the history and operation of the dam including photographs of the repairs made to the dam in 1976.

- 2.2 Construction Records. There are no construction records or as-built drawings available for the original construction of the dam, dike or appurtenances. As-built drawings and photographs of the repairs to the dam in 1976 are available. Previous inspection reports provided some construction information, and a summary of repairs and post-construction changes at the site.

- 2.3 Operating Records. No operating records are available, and there is no daily record kept of the elevation of the pool or rainfall at the dam site.

2.4 Evaluation

- a. Availability. There is limited engineering data available for the dam and no information available for the dike.
- b. Adequacy. The lack of detailed hydraulic, structural, and construction data did not allow for a definitive review of either structure. Therefore, the evaluation of the adequacy of the dam and dike is based on the visual inspection, past performance history, and engineering judgment.
- c. Validity. Comparison of the available drawings with the field survey conducted during the Phase I inspection indicates that the available information is valid.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The Phase I Inspection of the dam and dike at Factory Hollow Pond was performed on August 19, 1980. A copy of the inspection checklist is included in Appendix A. Previous biennial inspections were conducted from 1966 to 1976 for the Hampshire County Commissioners Office and by the Town of Amherst, and by the Massachusetts Department of Public Works in 1972, 1974, 1976. Copies of those reports are given in Appendix B. Selected photographs taken during our Visual Inspection are included in Appendix C.

b. Factory Hollow Dam

The dam is a stone masonry structure with a concrete cap, a vertical downstream face, a sloping upstream face and 3 outlets. The dam functions as a spillway (see Photo No. 1). Evidence of leakage was noted at 6 locations at the toe of the dam and along both abutments. The leakage is indicated by clear water flowing through the joints of the stone masonry. There are 2 leaks (seeps) to the right of the low level outlet flowing at approximately 5 gpm each and 4 seeps to the left of the low level outlet flowing at approximately 2, 2, 3 and 3 gpm respectively (see Photo No. 8).

Along the right abutment seepage was observed in the area of the penstock at the contact between the stone masonry and the rock abutment. The flow was estimated at a rate of 15 to 20 gpm (see Photo No. 7). Seepage was also noted at the left abutment and the flow was estimated to be at a rate of 3 gpm (see Photo No. 6).

The new concrete cap on the top of the dam which was installed in 1976 is in good condition. However, the section of the concrete cap not repaired in 1976 is cracked and mortar is missing. There was no erosion protection at the toe of the dam.

The stone masonry on the downstream face of the dam is in good condition.

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

Factory Hollow Dike

The dike is an earth embankment with grass slopes. There is no spillway, control structure or outlet at the dike location. There was no evidence of seepage along the downstream toe of the dike (see Photo No. 9). However, the pond level at the time of the inspection was below the toe of the dike.

Slight erosion was noted on the upstream face of the dike where some minor erosion of the slope was observed (see Photo No. 10).

Brush and trees up to 12 inches in diameter are growing on the upstream face of the dike (see Photo No. 9).

c. Appurtenant Structures

Factory Hollow Dam

The spillway, which is the dam, is a broad crested weir. At the time of the inspection, water was discharging over the spillway, so that the upstream face, sections of the top of the dam, the stone sluiceway, and downstream toe could not be examined. The concrete on the crest of the spillway was in good condition (see Photo No. 1).

There is no access walkway or controls for the upper level outlets (penstock and sluiceway) visible at the time of the inspection (see Photo No. 3 and 4). There is reportedly a steel plate on the upstream side of each of these outlets which was installed in a slide frame in 1974. The plates each have a hook which allows for a cable to be attached for removal by a crane. The tops of these steel plates are under 6 feet of water with the pond at normal level and located approximately 13 feet upstream of the top of the dam along the right abutment (see Figure B-4). The downstream end of the 36-inch diameter pipe (penstock) is in poor condition. It is severely corroded and there is some seepage flowing around it. The discharge end is clear of debris, and a slight amount of flow was discharging at the time of inspection (see Photo No. 7). It was not possible to determine the condition of the sluiceway since water was flowing over the spillway and prevented inspection of the outlet end (see Photo No. 5).

There was no access walkway or controls for the low level outlet at the time of inspection (see Photo No. 3 and 4). There is reportedly a manhole which houses the control

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

for the low level outlet that is located approximately 20 feet upstream of the dam. When the pond is at the spillway crest (El 223) this manhole is under 9 feet of water. Therefore, it is not possible to determine the operability of the gate valve on the low level outlet unless the water level is lowered about 9 feet. Small leakage was noted to be flowing from the downstream end of the low level outlet at the time of the inspection (see Photo No. 8)

Factory Hollow Dike has no spillway or outlets.

- d. Reservoir Area. The pond area is sparsely developed. Limited residential development is located to each side and immediately downstream of the pond. Most of the land has gentle slopes and is wooded. A sand and gravel operation is located 1,000 feet east of the pond. There is a low area located to the left of the dam in natural ground which during the test flood, would be overtopped and would act as an emergency spillway. The top of this low area is a paved driveway for the house adjacent to the dam.

- e. Downstream Channel

Factory Hollow Dam

Both the spillway and the outlets discharge into the downstream channel. The slopes that form the sides of the stream channel are slightly eroded (see Photo No. 2). The floor of the stream is the natural streambed. There is minor accumulation of wood debris in the floor of the stream.

Vegetation and trees up to 18 inches in diameter overhang the sides of the stream.

About 125 feet downstream of the dam, a bridge spans the downstream channel. The bridge opening is 29.5 foot wide by 12 foot high.

- 3.2 Evaluation. The visual inspection indicates that the Factory Hollow Dam and Dike are in fair condition. The stated deficiencies which must be corrected to assure the continued performance of these structures and measures to improve these conditions are outlined in Section 7.

SECTION 4
OPERATING AND MAINTENANCE
PROCEDURES

4.1 Operating Procedures

- a. General. There are no operating facilities and no regular operating procedures for the dam or dike. The condition of the dam or dike is not checked regularly.
- b. Warning System. There is no warning system in effect at either the dam or the dike.

4.2 Maintenance Procedures

- a. General. The dam and dike are not adequately maintained. The Town of Amherst Conservation Commission is responsible for maintenance of the dam. Periodic technical inspections have been conducted in the past.
- b. Operating Facilities

Factory Hollow Dam. The operating facilities at the dam are not maintained. In 1974, steel plates were installed on the upstream end of the upper level outlets. The top of these plates are under approximately 6 feet of water when the pond is at El 223. In 1976, the low level outlet was replaced. This outlet has not been operated since installation and is not accessible unless the pond level is lowered about 9 feet.

Factory Hollow Dike. There are no operating facilities at the dike.

- 4.3 Evaluation. There are no regular programs of maintenance or technical inspections at the dam or dike. There are also no plans for surveillance of the dam or dike during periods of heavy rainfall, or for warning people in downstream areas in the event of an emergency at either structure. The lack of standard operating and maintenance procedures is undesirable, considering that the dam is in the "high" hazard category and the dike in the "significant" hazard category. These programs should be implemented as recommended in Section 7.3.

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

SECTION 5

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

- 5.1 General. Factory Hollow Dam and Dike have a drainage area of 15 square miles of which 3.7 percent is ponds and swamps (see Figure D-1, Drainage Area Map). The land is gently rolling to hilly, and lightly developed.

There is one dam upstream of Factory Hollow Pond that provides additional storage within the watershed.

Factory Hollow Pond has a surface area of approximately 8 acres, and a maximum storage capacity of 80 acre-feet at El 223. Under normal flow conditions, access to the controls for the low level outlet are under 9 feet of water and during an emergency would be inoperable. Therefore, the upper level outlets would have to be utilized to draw down the reservoir. In an emergency, the upper level outlets would also be inoperable since the top of the plates are under 6 feet of water. The lowest of these two upper level outlets is the 36-inch diameter penstock. This outlet can discharge a flow of 100 cfs when the pond is at El 223 which is the crest of the spillway (dam). At this pond elevation and with no additional inflow, the penstock can lower the pond by 1 foot in about 1 hour.

- 5.2 Design Data. There are no hydraulic or hydrologic computations available for the design of the spillway at Factory Hollow Dam. Factory Hollow Dike has no spillway.
- 5.3 Experience Data. The original dam at this site was overtopped and washed out during heavy rains in 1893. Records of pond elevations are not maintained at this site. However, neighbors recall that during the 1955 hurricane, water was approximately 4 feet above the top of the spillway.
- 5.4 Test Flood Analysis. Factory Hollow Dam and Dike have been classified in the "small" size and "high" and "significant" hazard categories respectively. According to the Corps of Engineers guidelines, a test flood ranging from one half the PMF (Probable Maximum Flood) to the full PMF should be used to evaluate the capacity of the spillway. The one-half PMF rate was selected because of the small size of the pond.

The PMF for the Factory Hollow Pond watershed was calculated to be 1,200 cfs per square mile of drainage area. This calculation is based on the average slope of 1.97 percent in the drainage area, the pond-plus-swamp area to drainage area

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

area ratio of 3.7 percent, and the U.S. Army Corps of Engineer's guide curves for Maximum Probable Flood Peak Flow Rates (dated December 1977). For this analysis, the peak flow rate was determined to be between the guide curve for rolling and flat and coastal topography.

Applying the one-half PMF to the 15 square mile drainage area results in a peak test flood inflow of 9,000 cfs. By adjusting the test flood inflow for surcharge storage, the peak test flood outflow was calculated to be 8,920 cfs (578 cfs per square mile). Approximately 7,470 cfs of the outflow would flow over the dam, 480 cfs over the dike and 970 cfs would flow over the low area. The test flood would result in the pond rising to El 231.3.

Hydraulic analyses indicate that the spillway at Factory Hollow Dam can discharge 6,020 cfs or 67 percent of the test flood outflow with the pond at El 230 which is the low point at Factory Hollow Dike. There is also a low area in natural ground 66 feet long located 125 feet east of the left dam abutment which would act as an emergency spillway and has a low point of El 228.4. At this point water would flow over a driveway and rejoin the Mill River downstream of the bridge at Mill Street. At this elevation the Factory Hollow Dam spillway could discharge 3,670 cfs, or 41 percent of the outflow before this low area is overtopped.

5.5 Dam Failure Analysis

Factory Hollow Dam

The peak discharge rate due to failure of the dam was calculated to be 20,700 cfs with the pond at El 228.4. This calculation is based on a maximum head of 5.4 feet over the top of the dam (spillway) and an assumed 50-foot wide breach occurring in the center of the dam. Failure of the dam would produce a flood 14 feet deep 220 feet downstream of the dam as compared to channel flow 9 feet deep prior to failure with the pond at El 228.4.

There are six apartment buildings and three houses located along the stream 220 feet downstream of the dam. The foundations of these structures are approximately 8 feet above the floor of the stream. Due to the configuration of the stream channel, little attenuation of the flood flow is expected. An assumed failure of the dam could result in a flood wave that would rise above the foundation level of these structures resulting in the possible loss of more than a few lives and an excessive amount of property damage. Accordingly, the dam has been placed in the "high" hazard category.

Factory Hollow Dike

The peak discharge rate due to failure of the dike was calculated to be 490 cfs with the pond at El 230. This calculation is based on a maximum head of 3 feet and an assumed 56-foot wide breach occurring in the center of the embankment. Failure of the dike would produce a downstream flood wave 2 feet deep where there was none previously.

There is one house located 100 feet downstream of the dike. The foundation of this structure is approximately 6 feet below the base of the dike. There are 6 apartment buildings 200 feet downstream of the dike which are 28 feet below the base of the dike. An assumed failure of the dike could result in a flood wave causing an appreciable amount of property damage to the house and flooding in the parking lot for the apartment buildings. Accordingly, the dike has been placed in the "significant" hazard category.

SECTION 6
STRUCTURAL STABILITY

- 6.1 Visual Observations. The evaluation of the structural stability of Factory Hollow Dam and Dike are based on a review of previous inspection reports, a review of available drawings, and the visual inspection conducted on August 19, 1980.

As discussed in Section 3, Visual Inspection, the dam and dike are in fair condition. Some erosion has occurred at the downstream toe due to the falling water which in time could undermine the toe of the dam. Seepage was observed along the base of the dam and at the abutments. The as-built drawings from 1977 indicate rubble and 12-inch by 14-inch timbers beneath the structure. Due to the seepage occurring, a stability analyses should be performed to determine safety factors against failure for sliding and overturning for the dam in its present condition under normal water levels and also for the test flood.

- 6.2 Design and Construction Data. The original Factory Hollow Dam built in 1860 was washed out in 1893. Construction of the existing Factory Hollow Dam was completed in 1895. Computations for design of the dam, dike, spillway and outlet are not available.

Drawings showing the proposed or as-built construction of the dam, and dike are not available.

Specifications for construction of the dam and dike are not available.

There is no information on the shear strength or permeability of the soil and/or rock materials of the dam or dike.

- 6.3 Post-Construction Changes. Since the original construction of the dam, several changes/repairs have been made.

1947 - Upstream face of dam repaired - control structure for sluiceway and penstock repaired.

1974 - Steel plates installed over upstream face of penstock and sluiceway. Downstream portion of penstock pipe removed.

1976 - Upstream face of dam repaired - 8" thick reinforced concrete slab placed over 60 percent of upstream face. New low level outlet installed.

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

6.4 Seismic Stability. The dam is located in Seismic Zone No. 2, and in accordance with Corps of Engineers' guidelines does not warrant further seismic analysis at this time.

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

- a. Condition. As a result of the visual inspection, the review of available data, and limited information on operation and maintenance, the Factory Hollow Dam and Dike are considered to be in fair condition.

Factory Hollow Dam

The following deficiencies must be corrected to assure the continued performance of this dam: seepage along base of dam through masonry joints; seepage along the dam abutments; leakage through low level outlet; deteriorated condition of penstock pipe through dam; inoperability and lack of accessibility to the gate valve on the low level outlet and the upper level outlets; lack of erosion protection at the toe of the dam; mortar missing from the stone masonry on the top of the dam at the right abutment.

Factory Hollow Dike

The following deficiencies must be corrected to assure the continued performance of this dike: minor erosion of the upstream face of the dike, trees and brush growing on upstream face of the dike, lack of erosion protection on upstream face of the dike.

The peak test flood (1/2 PMF) outflow is estimated to be 8,920 cfs with the pond at El 231.3. Hydraulic analyses indicate that the spillway can discharge 6,020 cfs or 67 percent of the test flood outflow before the dike is overtopped. There is a low area 66 feet long located 125 feet east of the left dam abutment which has a low point of El 228.3. The spillway could discharge 3,670 cfs or 41 percent of the outflow before this area is overtopped.

- b. Adequacy. The lack of detailed design and construction data did not allow for a definitive review. Therefore, the evaluation of this dam is based on a review of the available data, the visual inspection, past performance and engineering judgment.

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

- c. Urgency. The recommendations and remedial measures outlined below should be implemented by the Owner within 1 year after receipt of this Phase I Inspection Report.

7.2 Recommendations. It is recommended that the Owner employ a qualified registered engineer to:

Factory Hollow Dam

- a. Conduct an investigation of the seepage noted at the base and abutments of the dam. This would also include an evaluation of the dam stability. The condition of upstream face of the dam should also be examined at the same time.
- b. Review the need for and design controls for the operation of the low and upper level outlets.
- c. Design erosion protection for the toe of the dam to prevent overflowing water from washing out the downstream toe area.
- d. Evaluate need to complete the concrete slab on the upstream face of the dam which was partially constructed in 1976.

Factory Hollow Dike

- a. Develop procedures for clearing brush and trees, and backfilling of the embankment.

The Owner should implement the recommendations of the Engineer.

7.3 Remedial Measures

- a. Operating and Maintenance Procedures. It is recommended that the Owner accomplish the following:

Factory Hollow Dam

- (1) Repair cracked mortar on the concrete cap of the dam near the right abutment.
- (2) Remove all brush, trees, and debris in the spillway discharge channel.

Factory Hollow Dike

- (1) Provide erosion protection on the upstream face of the dike.

Factory Hollow Dam and Dike

- (1) Institute a definite plan for surveillance of the dam and dike during and after periods of heavy rainfall and a plan to warn people in downstream areas in the event of an emergency at the dam or dike.
- (2) Implement a systematic program of maintenance inspections. As a minimum, the inspection program should consist of a monthly inspection of the dam and appurtenances and be supplemented by additional inspections during and after severe storms. All repairs and maintenance should be undertaken in compliance with all applicable State regulations.
- (3) Institute a program of technical inspections on an annual basis.

7.4 Alternatives. There are no practical alternatives to the above recommendations.

APPENDIX A
PERIODIC INSPECTION CHECKLIST

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

PERIODIC INSPECTION

PARTY ORGANIZATION

PROJECT FACTORY HOLLOW DAM AND DIKE

DATE August 19, 1980

TIME 8 A.M. - 3 P.M.

WEATHER Cloudy-Rain

W.S. ELEV. 223 U.S. 194.7 M.S.L.

PARTY:

1.	W. Cheechi	Metcalf & Eddy - Geotechnical
2.	N. D'Agostino	Metcalf & Eddy - Geotechnical
3.	F. Gordon	Metcalf & Eddy - Geotechnical
4.	E. Greco	Metcalf & Eddy - Geotechnical
5.	S. Nagel	Metcalf & Eddy - Geotechnical
6.	M. Nowak	Metcalf & Eddy - Hydraulics
7.	D. Meritt	Town of Amherst - Engineering Dept.
8.		
9.		
10.		

PROJECT FEATURE	INSPECTED BY	REMARKS
1. Dam (Factory Hollow Dam)	N. D'Agostino/S. Nagel/E. Greco	
2. Dike (Factory Hollow Dike)	N. D'Agostino/S. Nagel/E. Greco	
3. Outlet Works - Spillway	N. D'Agostino/M. Nowak	
4. Outlet Works-Upper and Low Level Outlets	N. D'Agostino/M. Nowak	
5.		

PERIODIC INSPECTION CHECK LIST

PROJECT FACTORY HOLLOW DAM

DATE August 19, 1980

PROJECT FEATURE Dam

NAME N. D'Agostino

DISCIPLINE Geotechnical

NAME S. Nagel

AREA EVALUATED	CONDITIONS
<u>DAM EMBANKMENT</u>	
Crest Elevation	223 to 224.7
Current Pool Elevation	223
Maximum Impoundment to Date	Unknown-Reported by neighbors Water 4' over crest in 1955
Surface Cracks	N/A-cut stone masonry dam-dry wall construction
Pavement Condition	N/A
Movement or Settlement of Crest	None visible
Lateral Movement	None visible
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Seepage, along interface between dam and left and right abutments- rt.abutment seepage 15 to 20 gpm - lt.abut. 3 gpm trees at right abutment.
Indications of Movement of Structural Items on Slopes	None visible
Trespassing on Slopes	None-D/S face of dam vertical Trespassing evident along right abutment
Sloughing or Erosion of Slopes or Abutments	None-abutments are rock outcrops
Rock Slope Protection - Riprap Failures	Not applicable
Unusual Movement or Cracking at or near Toes	None visible
Unusual Embankment or Downstream Seepage	6 seeps along base of dam - 2 to rt. of low level outlet (LLO), 5gpm each - 4 to lt. of (LLO) - 2 @ 2 gpm; 2 @ 3 gpm - Approx. 2gpm through (LLO); approx. 1 gpm thru Penstock
Piping or Boils	None visible
Foundation Drainage Features	None visible
Toe Drains	None visible
Instrumentation System	None

PERIODIC INSPECTION CHECK LIST

PROJECT FACTORY HOLLOW DIKE DATE August 19, 1980
 PROJECT FEATURE Dike NAME N. D'Agostino
 DISCIPLINE Geotechnical NAME S. Nagel

AREA EVALUATED	CONDITIONS
<u>DAM EMBANKMENT</u>	
Crest Elevation	230
Current Pool Elevation	223
Maximum Impoundment to Date	Unknown-Reported by neighbors to be 4' over Dam crest in 1955
Surface Cracks	None
Pavement Condition	Grass
Movement or Settlement of Crest	None visible
Lateral Movement	None
Vertical Alignment	Good
Horizontal Alignment	Straight
Condition at Abutment and at Concrete Structures	N/A
Indications of Movement of Structural Items on Slopes	None - trees and brush growing on upstream face of dam
Trespassing on Slopes	None
Sloughing or Erosion of Slopes or Abutments	Slough on U/S face @ <u>2</u> approx. 2.5 wide; .5' deep; 4.5' long
Rock Slope Protection - Riprap Failures	N/A
Unusual Movement or Cracking at or near Toes	None
Unusual Embankment or Downstream Seepage	None
Piping or Boils	None
Foundation Drainage Features	None
Toe Drains	None
Instrumentation System	None

Factory Hollow Dike has no spillway or outlets.

PERIODIC INSPECTION CHECK LIST

PROJECT FACTORY HOLLOW DAM DATE August 19, 1980
 PROJECT FEATURE Spillway NAME N. D'Agostino
 DISCIPLINE Geotechnical NAME M. Nowak

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS</u>	
a. Approach Channel	
General Condition	Submerged
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Yes - largest 12" diameter
Floor of Approach Channel	Submerged
b. Weir and Training Walls	Ledge
General Condition of Concrete	Good
Rust or Staining	None
Spalling	None
Any Visible Reinforcing	No
Any Seepage or Efflorescence	No
Drain Holes	None
c. Discharge Channel	
General Condition	Good-several logs in channel
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Several
Floor of Channel	Gravel
Other Obstructions	Bridge 125 feet D/S of dam

PERIODIC INSPECTION CHECK LIST

PROJECT FACTORY HOLLOW DAM DATE August 19, 1980
 PROJECT FEATURE Upper & Lower Level Outlets NAME N. D'Agostino
 DISCIPLINE Geotechnical NAME M. Nowak

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL</u>	
<u>General Condition of Concrete</u>	
<u>Rust or Staining</u>	
<u>Spalling</u>	
<u>Erosion or Cavitation</u>	
<u>Visible Reinforcing</u>	
<u>Any Seepage or Efflorescence</u>	
<u>Condition at Joints</u>	
<u>Drain Holes</u>	
<u>Channel</u>	
<u>Loose Rock or Trees Over- hanging Channel</u>	
<u>Condition of Discharge Channel</u>	

Upper Level Outlets:

Penstock - 36" diameter @ D/S face - in 1974 had new steel plate inserted on U/S face - visible portion badly corroded steel-no controls
 Penstock leaking at approx. 1 gpm.

Sluiceway- Rectangular - 3' wide x 3' high opening in stone masonry dam.
 Also in 1974 new steel plate inserted on U/S face. D/S opening could not be inspected. Located directly beneath spillway-no controls.

Low Level Outlet

16" diameter ductile iron pipe installed in 1976 control structure is a manhole built on upstream side of dam. Under 10 feet of water when pond at spillway crest. Gate valve installed on U/S side of pipe. No means available to open.
 Low level outlet leaking at approximately 2 gpm.

PERIODIC INSPECTION CHECK LIST

PROJECT FACTORY HOLLOW DAM

DATE August 19, 1980

PROJECT FEATURE Intake

NAME N. D'Agostino

DISCIPLINE Geotechnical

NAME M. Nowak

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE</u>	
a. Approach Channel	Not visible - submerged
Slope Conditions	
Bottom Conditions	
Rock Slides or Falls	
Log Boom	
Debris	
Condition of Concrete Lining	
Drains or Weep Holes	
b. Intake Structure	Submerged
Condition of Concrete	
Stop Logs and Slots	

Intake is through a 16" diameter pipe which enters into a manhole on U/S face of dam. In manhole is gate valve which is used to control flow through pipe. There is no control key for this valve. Installed in 1976, it has never been used. Low level outlet pipe presently is leaking.

APPENDIX B
PLANS OF DAM AND PREVIOUS
INSPECTION REPORTS

	<u>Page</u>
Figure B-1, Plan of Dam and Dike	B-1
Figure B-2, Sections through Dam and Dike	B-2
Figure B-3, Drawing of Dam, dated March, 1977	B-3
Figure B-4, Drawing of Dam, dated March, 1977	B-4
Boring Logs	B-5
Previous Inspection Reports - Factory Hollow Dam	
Performed by Tighe & Bond Consulting Engineers For the Hampshire County Board of County Commissioners	
Dated July 20, 1966	B-7
June 26, 1968	B-9
October 6, 1968	B-11
February 12, 1970	B-13
Dated December 14, 1972 by Massachusetts Department of Public Works	B-15
Performed by Tighe & Bond Consulting Engineers for Town of Amherst dated June 11, 1974	B-23
Dated December 3, 1974 by Massachusetts Department of Public Works	B-27
Performed by Tighe & Bond Consulting Engineers for Town of Amherst dated October 26, 1976	B-32
Dated February 10, 1977 by Massachusetts Department of Public Works	B-34
Previous Inspection Reports - Factory Hollow Dike	
Dated December 14, 1972 by Massachusetts Department of Public Works	B-35
Dated January 22, 1975 by Massachusetts Department of Public Works	B-43
FACTORY HOLLOW DAM FACTORY HOLLOW DIKE	

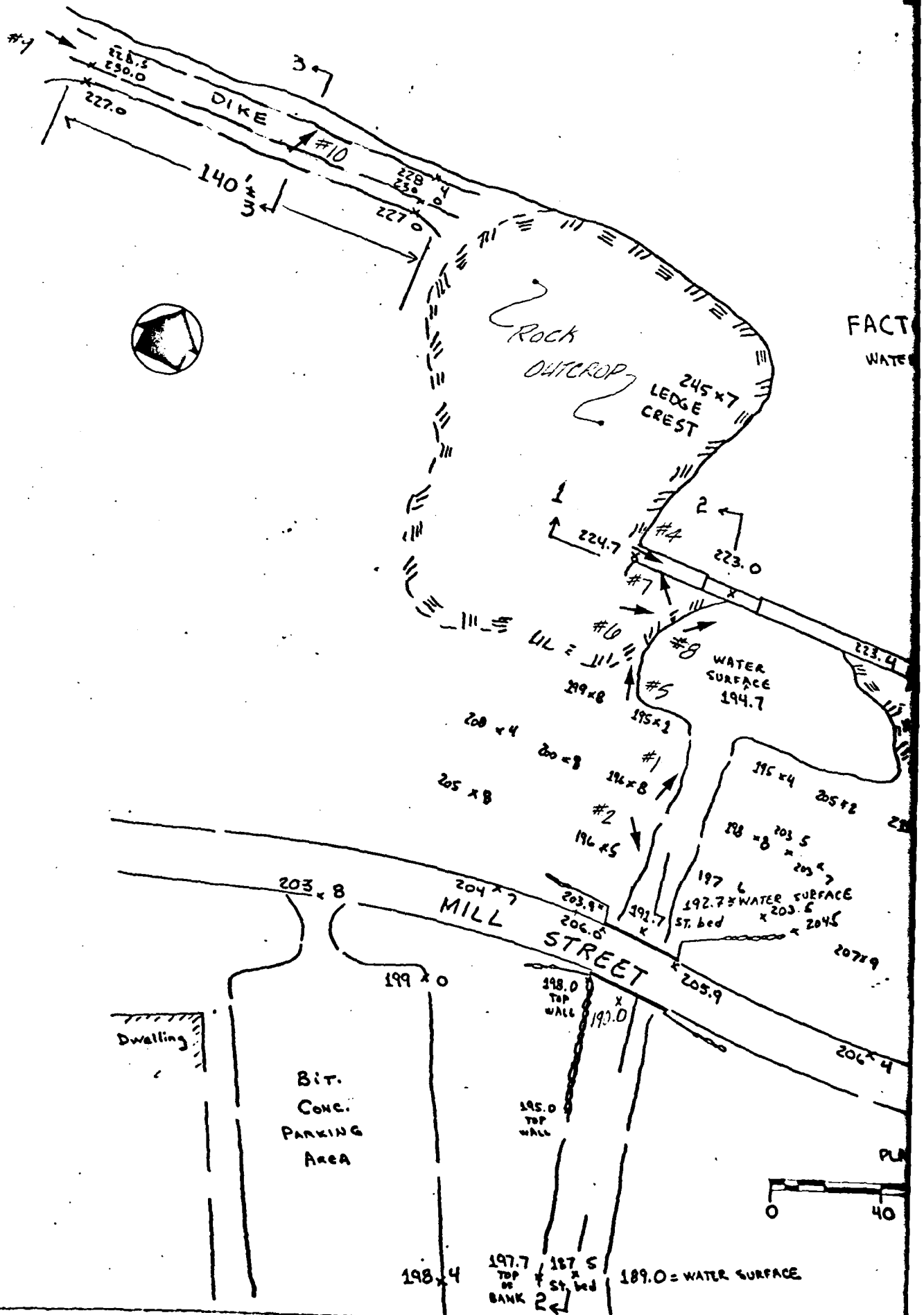
APPENDIX B (Continued)

Page

Dated November 17, 1976 by Massachusetts
Department of Public Works

B-47

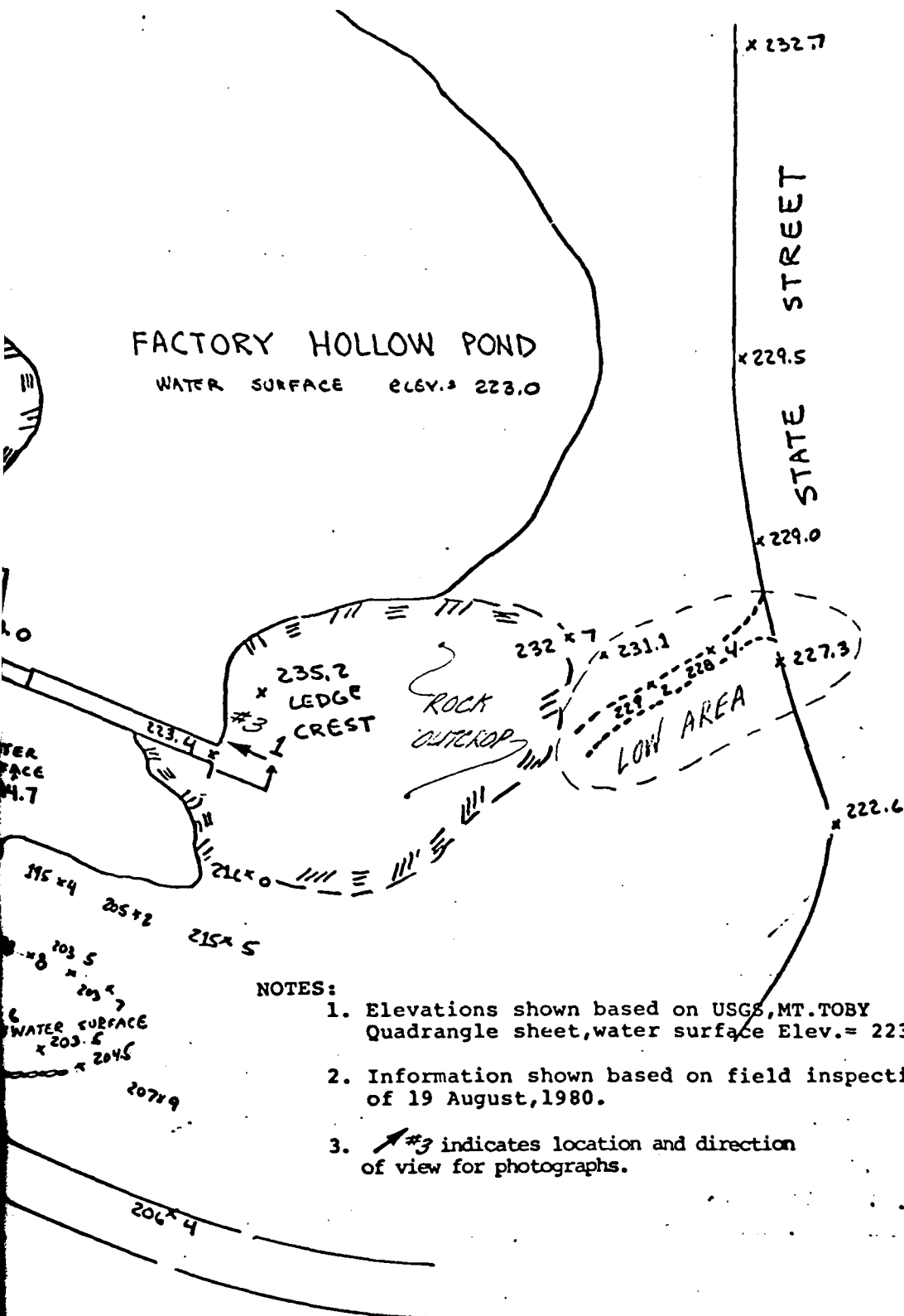
FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE



①

FACTORY HOLLOW POND

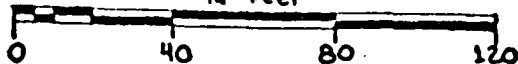
WATER SURFACE ELEV. = 223.0



NOTES:

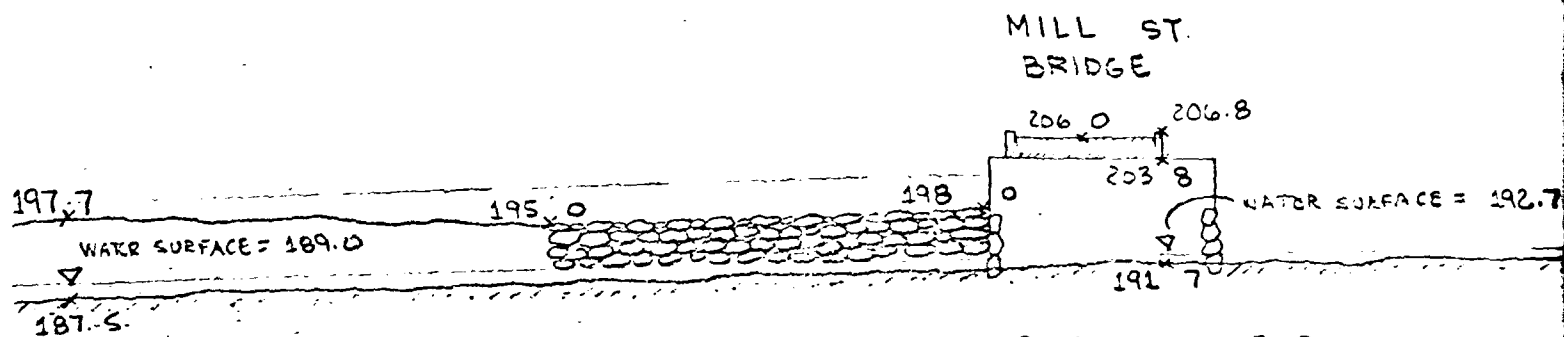
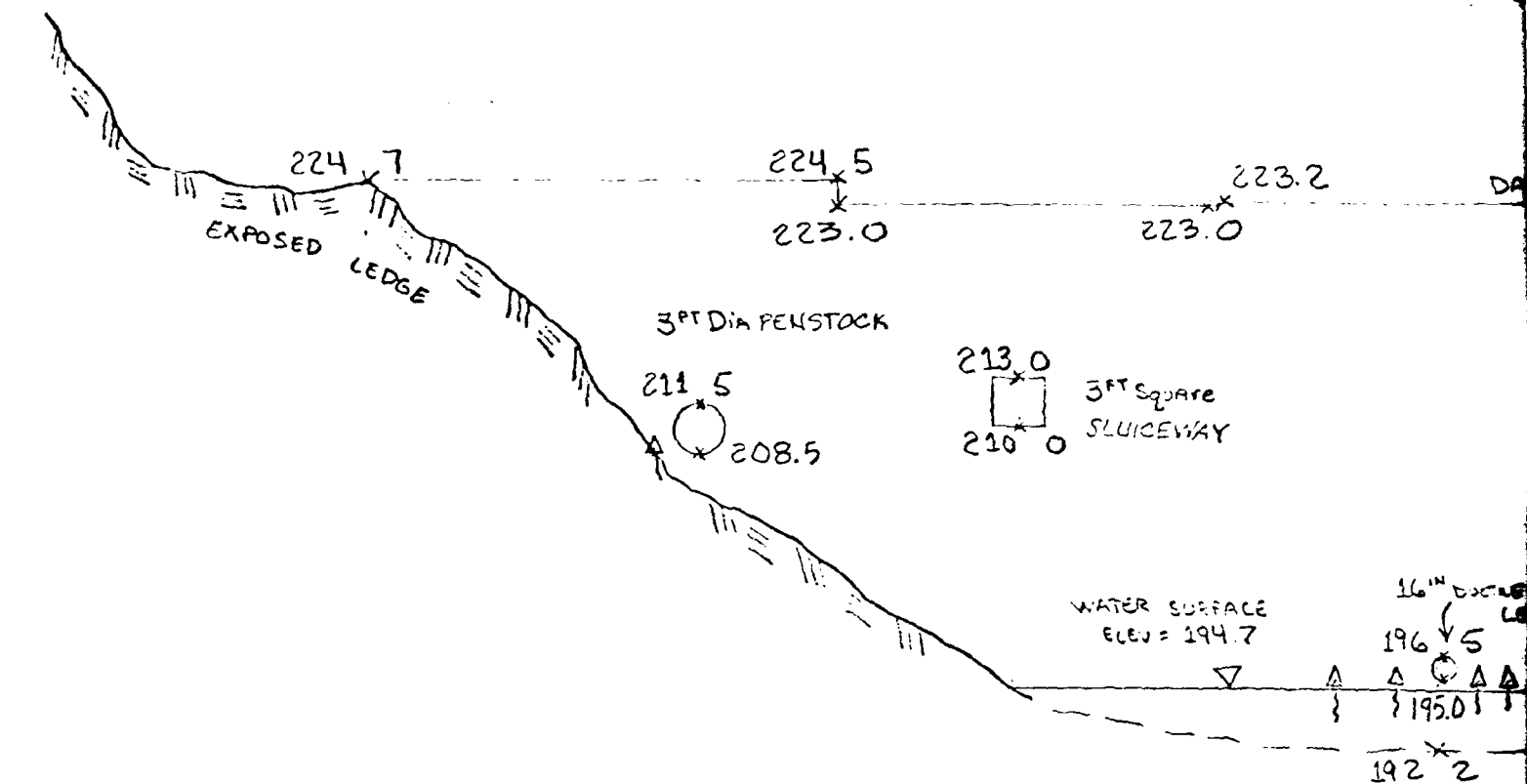
1. Elevations shown based on USGS, MT. TOBY Quadrangle sheet, water surface Elev. = 223.0.
2. Information shown based on field inspection of 19 August, 1980.
3. #3 indicates location and direction of view for photographs.

PLAN SCALE
IN FEET



2

NETCALF & EDDY, INC. ENGINEERS BOSTON, MA.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS BALTIMORE, MD.
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	
FACTORY HOLLOW DAM AND DIKE	
FIGURE B-1 PLAN OF DAM AND DIKE	
TRIBUTARY CONNECTICUT RIVER	MASSACHUSETTS
SCALE: AS SHOWN	DATE: SEPTEMBER, 1980

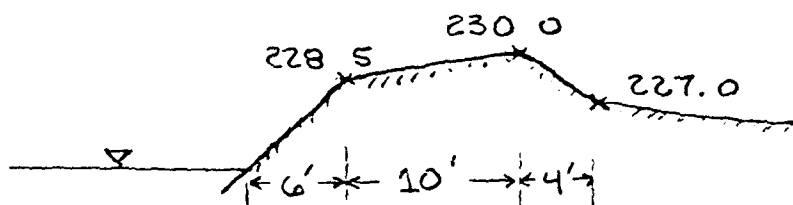


SECTION 2-2

DAM, BRIDGE, AND CHANNEL
PROFILE

SCALE 1 IN = 20 FT
(HORIZONTAL AND VERTICAL)

Note



SECTION 3-3 DIKE

SCALE 1 IN = 10 FT
(HORIZONTAL AND VERTICAL)

①

DAM CREST 7

223 4

SECTION 1-1

DAM CREST

SCALE 1 in = 10 ft
(HORIZONTAL and VERTICAL)

16" DUCT IRON LOW
LEVEL OUTLET

196 5

195.0

192 2

WATER SURFACE
= 223.0

SPILLWAY CREST

224 5

223 4

213 0


210 0

WATER SURFACE = 192.7

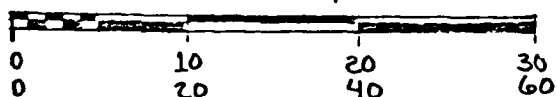
WATER SURFACE = 194.7

192 2

Notes:

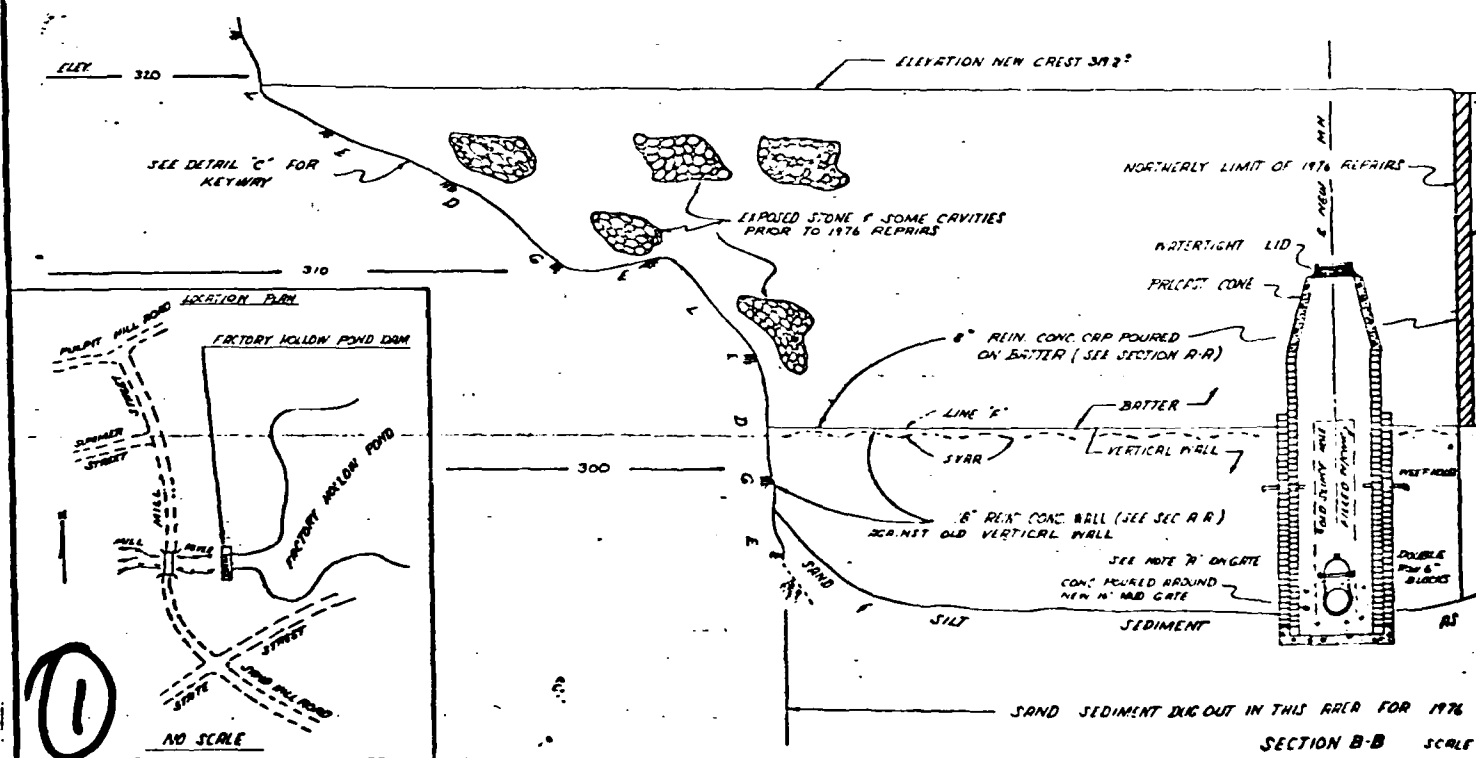
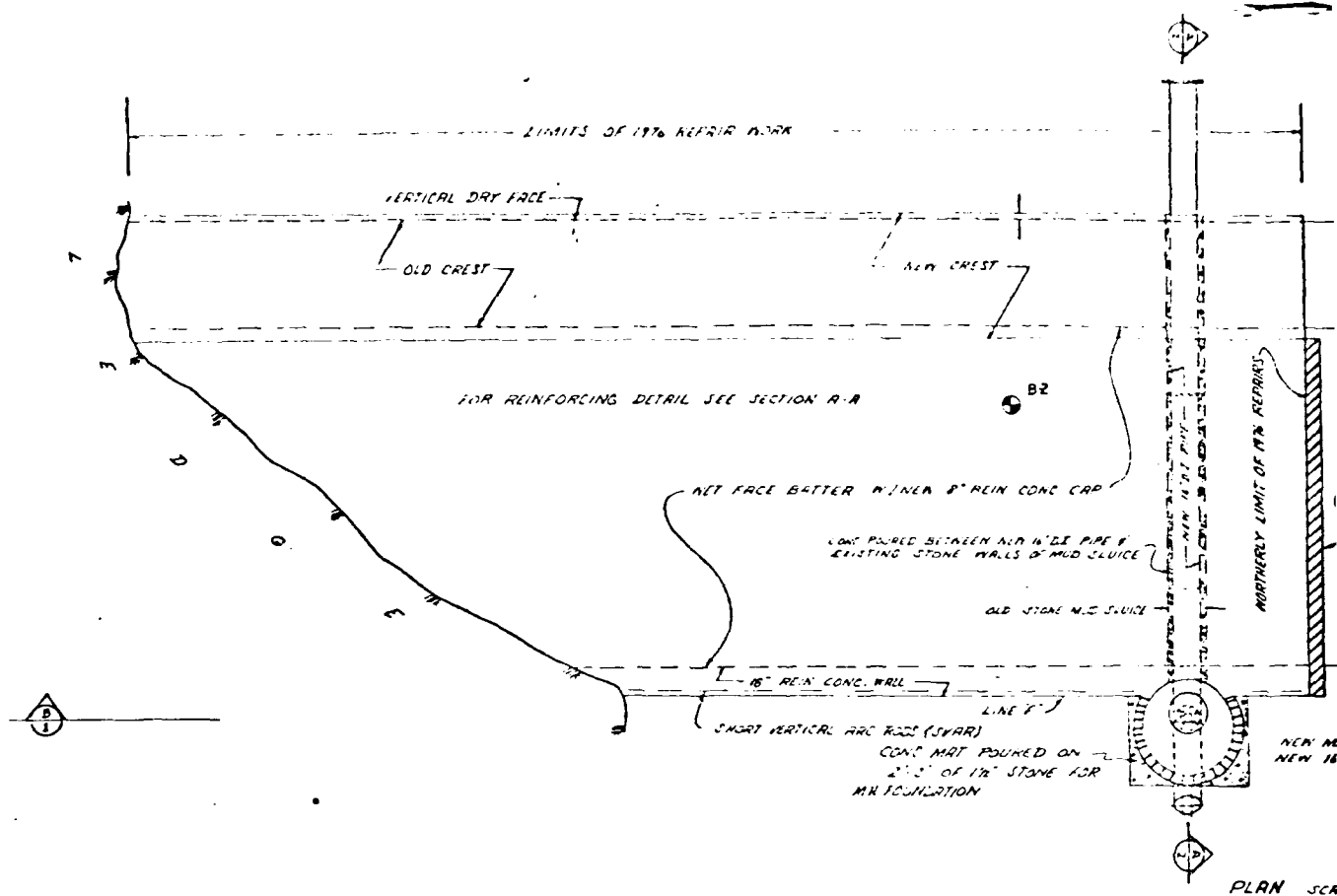
1. Elevations shown based on USGS, MT. TOBY
Quadrangle sheet, water surface Elev. = 223.0.
2. Information shown based on field inspection
of 19 August 1980.
3.  indicates seepage point.

SCALE
IN FEET



2

METCALF & EDDY, INC. ENGINEERS BOSTON, MA.	U. S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA.
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	
FACTORY HOLLOW DAM AND DIKE	
FIGURE B-2 SECTIONS THROUGH DAM AND DIKE	
TRIBUTARY CONNECTICUT RIVER	MASSACHUSETTS
SCALE: AS SHOWN	DATE: SEPTEMBER, 1980



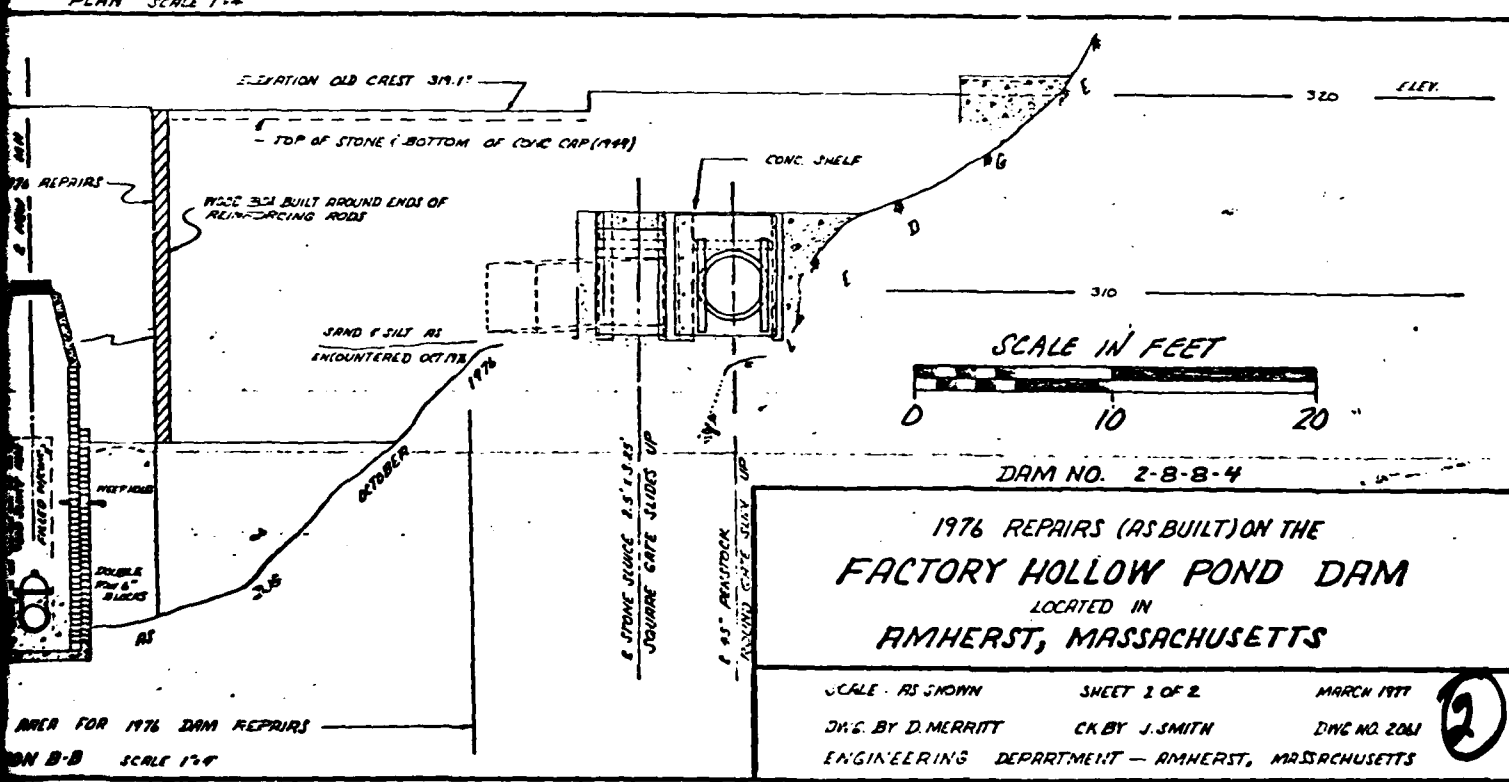
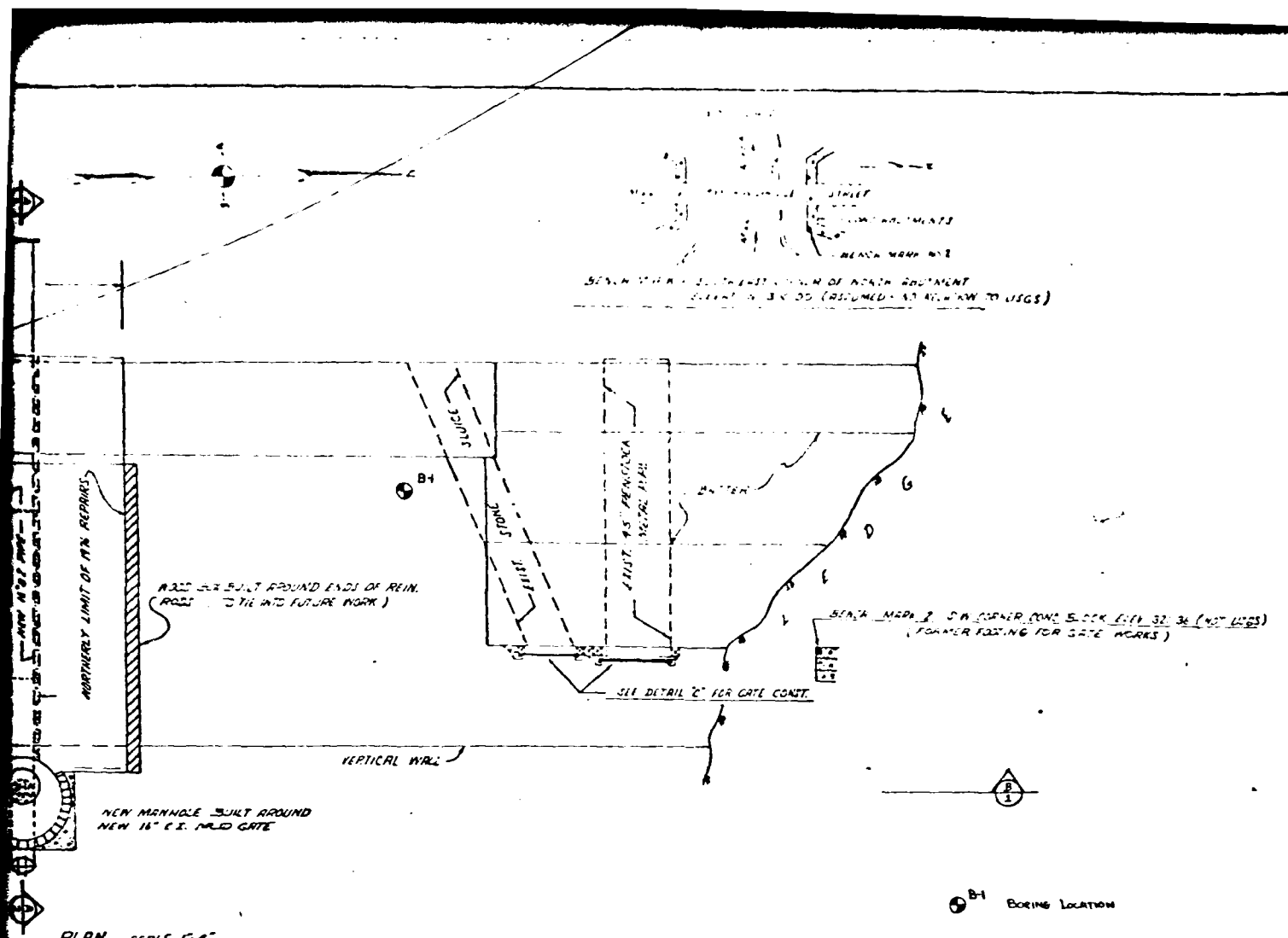
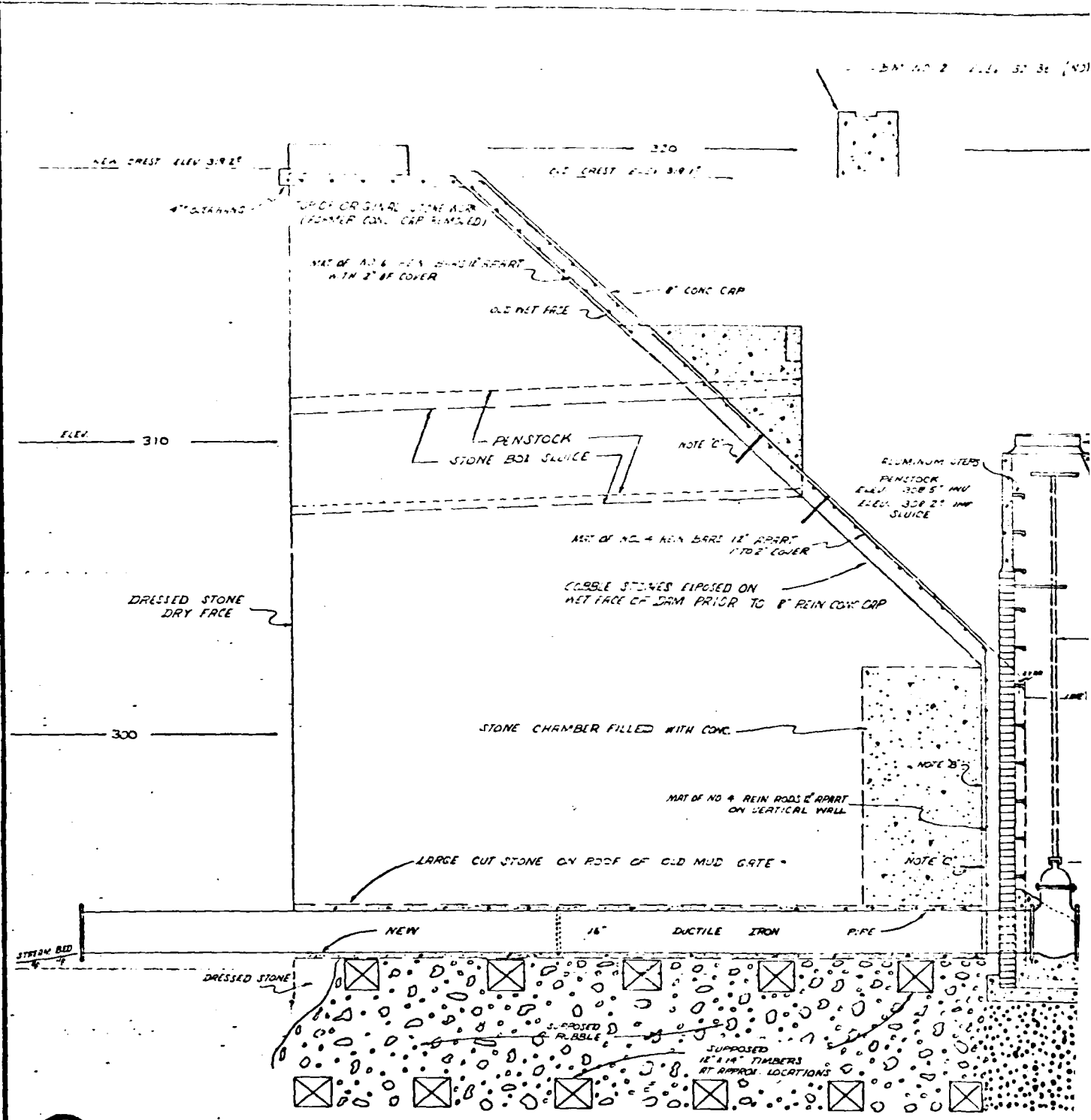


Figure B-3

GENERAL

NOTE E THE NEW 12' GATE AND 12' MUD GATE ARE 16' H.B. WALL (CONCRETE).

NOTE F THE NEW 12' GATE AND 12' MUD GATE ARE 16' H.B. WALL (CONCRETE). THE NEW 12' GATE AND 12' MUD GATE ARE 16' H.B. WALL (CONCRETE). THE NEW 12' GATE AND 12' MUD GATE ARE 16' H.B. WALL (CONCRETE).



SECTION A-A
SCALE 1"=8'

①

GENERAL NOTES

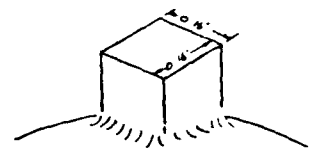
NOTES: 1. 1" PINS 18" LONG PLACED INTO
HOLE DRILLED INTO THE ENDURE
DAM AND VERTICAL KEY FACE WELDED
IN 1976. HOLE WERE SPACED 15" ON C.C.

32.36 (NOT USGS)

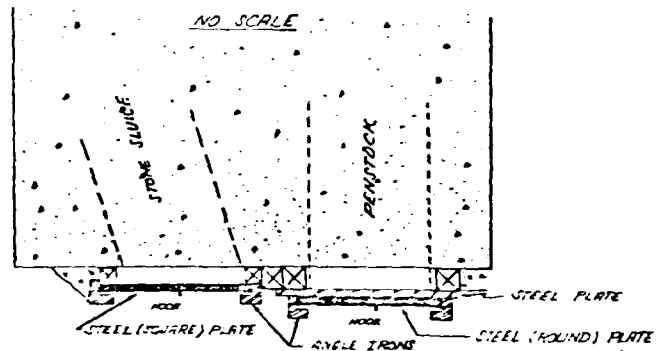
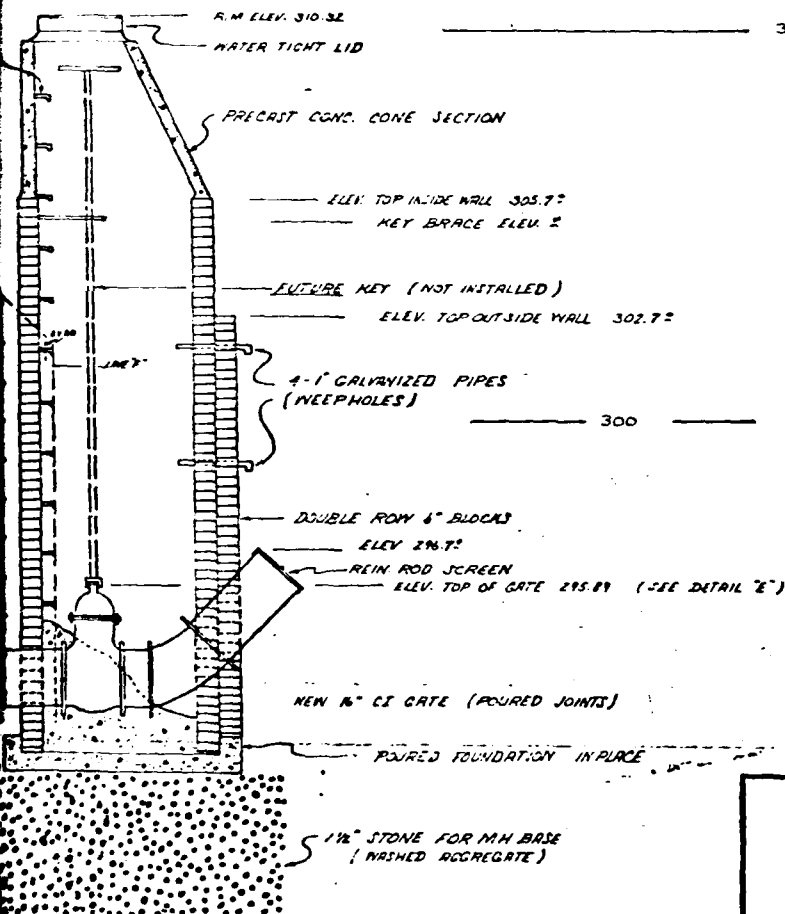
320



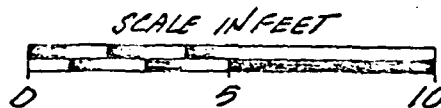
DETAIL 'C' OF KEYWAY



DETAIL 'E'



DETAIL 'D' GATE CONSTRUCTION



DAM NO. 2-8-8-4

1976 REPAIRS (AS BUILT) ON THE FACTORY HOLLOW POND DAM LOCATED IN AMHERST, MASSACHUSETTS

SCALE: AS SHOWN SHEET 2 OF 2 MARCH 1977
DWG. BY D. MERRITT CK. BY J. SMITH DWG. NO. 204
ENGINEERING DEPARTMENT AMHERST, MASSACHUSETTS

2

Figure B-4

GEORGE H. McDONNELL
PHILIP W. SHERIDAN
EDWARD J. BAYON

TIGHE & BOND

CONSULTING ENGINEERS

CIVIL, SANITARY AND ELECTRICAL ENGINEERING
INVESTIGATIONS, REPORTS, PLANS AND SPECIFICATIONS
SUPERVISION OF CONSTRUCTION AND OPERATION

BOWERS AND PEQUOT STREETS
HOLYOKE, MASSACHUSETTS
TEL. JEFFERSON 3-3991

H-36 Amherst
July 20, 1966

The Honorable the Board of County Commissioners
Hampshire County Court House
Northampton, Massachusetts

Gentlemen:

Each dam situated within the Town of Amherst has now been inspected by the undersigned at least once during the year 1966. Final inspections were made on Friday, July 15, 1966.

Attached hereto is a report on conditions noted at each of the four dams in the Town of Amherst. The contents of the report are self-explanatory.

Respectfully submitted,

Tighe & Bond, Inc.

George H. McDonnell
George H. McDonnell
Chief Engineer

GHM/mbf

1966 INSPECTION REPORT ON DAMS
SITUATED IN THE
TOWN OF AMHERST, MASS.

A. Factory Hollow Dam

This dam is in the same general condition as when last inspected in 1964. Leakage from the penstock gate discharges into the bed of the stream thru a hole cut in the penstock itself. The drawoff port thru the masonry dam discharges some water indicating that the gate is not tightly closed.

Major seepage and leakage occurs thru the face of the masonry dam and at the left abutment from the toe of the structure to about one-third its height. This leakage, though relatively large in quantity, does not endanger the dam. Most of the leakage occurs thru joints in the masonry and at the point where the masonry dam abuts the natural ledge. With the passing of time, the leakage will undoubtedly increase in quantity as the masonry and the natural ledge is worn by the leaking water.

The toe area of the dam was okay and conditions were no worse than noted previously.

The alignment and grade of the crest of the dam was fairly good and the face of the stone masonry structure showed no bulging or displacement of the masonry.

No flashboards were on the crest of the spillway and water level in storage was down about 6" from the masonry crest.

The right abutment area of the dam was in fair to good condition.

Though this dam receives very little maintenance and is becoming somewhat dilapidated, the structure is considered safe for the time being.

No changes have been made at this dam since the time of the last inspection.

B. Owen Farm Pond Dam

The embankment forming this small dam was found to be in very good condition. It is covered with a fairly good thick growth of turf except on the downstream face, at about the center of the dam where the surface has been chewed up from the hoofs of grazing cattle. This one section where little turf exists does not endanger the safety of the embankment.

GEORGE H. McDONNELL
PHILIP W. SHERIDAN
EDWARD J. BAYON

TIGHE & BOND CONSULTING ENGINEERS

CIVIL, SANITARY AND ELECTRICAL ENGINEERING
INVESTIGATIONS, REPORTS, PLANS AND SPECIFICATIONS
SUPERVISION OF CONSTRUCTION AND OPERATION

BOWERS AND PEQUOT STREETS
HOLYOKE, MASSACHUSETTS
TEL. JEFFERSON 3-3991

H-36 Amherst
June 26, 1968

The Honorable the Board of County Commissioners
Hampshire County Courthouse
Northampton, Massachusetts

Gentlemen:

Each dam situated within the limits of the Town of Amherst has now been inspected by the undersigned at least once during the year 1968. Final inspections were made on June 5, 1968.

Attached hereto, is a report on conditions noted at each of the five dams situated within the Town of Amherst. The contents of the report are self-explanatory.

Respectfully submitted,

Tighe & Bond, Inc.


George H. McDonnell
Chief Engineer

GHM/amd
Encl.

1968 INSPECTION REPORT ON DAMS
SITUATED IN THE
TOWN OF AMHERST, MASS.

A. Factory Hollow Dam

Water was overflowing the crest on the day of inspection. There were no flashboards on the crest. The crest was very well aligned and on good grade.

Both abutments of this dam consist of natural ledge. The abutment areas were o.k.

The toe area of this stone masonry dam was in satisfactory condition. Water falling from the crest of the spillway lands on large broken slabs and blocks of concrete placed along the toe of the dam to break up the force of the falling water. The pool below the toe of the dam was in satisfactory condition and no eroding force was noted in the water.

The dry masonry face of the dam was in good condition as to its stability and alignment. There were no projections and no bulging was noted.

A fairly large quantity of water seeps thru joints of the dam and at the point where the dam butts against the ledge at the left end. Leakage this year seemed to be more than previously noted. This leakage is not dangerous to the safety of the dam.

This dam receives very little maintenance. In spite of this fact, the structure was considered safe when inspected.

B. Owen Farm Pond Dam

The spillway tube thru the embankment was in good condition and contained no debris. The discharge portal was satisfactory. The inlet trash rack was in good condition and contained no debris. Water level in storage was down about 2 feet below the crest of the overflow structure. Leakage occurring around the steel plate covering the drawdown opening has apparently contributed to the low level of water stored by the dam embankment.

The embankment was noted to be in fair condition and to be covered with a good growth of turf. The swale spillway at the right of the embankment was o.k. and it too had a good turf cover. No changes have been made at this dam since the time of the last inspection and the structure was considered safe when checked.

1968 INSPECTION REPORT ON DAMS
SITUATED IN THE
TOWN OF AMHERST, MASS.

A. Factory Hollow Dam

Water was overflowing the crest on the day of inspection. There were no flashboards on the crest. The crest was very well aligned and on good grade.

Both abutments of this dam consist of natural ledge. The abutment areas were o.k.

The toe area of this stone masonry dam was in satisfactory condition. Water falling from the crest of the spillway lands on large broken slabs and blocks of concrete placed along the toe of the dam to break up the force of the falling water. The pool below the toe of the dam was in satisfactory condition and no eroding force was noted in the water.

The dry masonry face of the dam was in good condition as to its stability and alignment. There were no projections and no bulging was noted.

A fairly large quantity of water seeps thru joints of the dam and at the point where the dam butts against the ledge at the left end. Leakage this year seemed to be more than previously noted. This leakage is not dangerous to the safety of the dam.

This dam receives very little maintenance. In spite of this fact, the structure was considered safe when inspected.

B. Owen Farm Pond Dam

The spillway tube thru the embankment was in good condition and contained no debris. The discharge portal was satisfactory. The inlet trash rack was in good condition and contained no debris. Water level in storage was down about 2 feet below the crest of the overflow structure. Leakage occurring around the steel plate covering the drawdown opening has apparently contributed to the low level of water stored by the dam embankment.

The embankment was noted to be in fair condition and to be covered with a good growth of turf. The swale spillway at the right of the embankment was o.k. and it too had a good turf cover. No changes have been made at this dam since the time of the last inspection and the structure was considered safe when checked.

GEORGE H. McDONNELL
PHILIP W. SHERIDAN
EDWARD J. BAYON

**TIGHE
& BOND** CONSULTING ENGINEERS

CIVIL, SANITARY AND ELECTRICAL ENGINEERING
INVESTIGATIONS, REPORTS, PLANS AND SPECIFICATIONS
SUPERVISION OF CONSTRUCTION AND OPERATION

BOWERS AND PEQUOT STREETS
HOLYOKE, MASSACHUSETTS
TEL. JEFFERSON 3-3991

H-36 Amherst
October 6, 1968

The Honorable the Board of County Commissioners
Hampshire County Courthouse
Northampton, Massachusetts

Re: Epstein Dam
and
Factory Hollow Dam

Gentlemen:

The Undersigned has made inspections at the two above subject dams during September. The inspection of the Epstein Dam was conducted since this is a relatively new dam and periodic checks are being made of the embankment, the toe area, spillway, etc. The Factory Hollow Dam was inspected since this is a fairly high stone masonry dam and the undersigned wished to observe any increase in leakage that was noted previously, or any change that may have occurred in the enlargement of the face of this dam.

Epstein Dam

The grass cover on the embankment of this dam is improving on the slopes and particularly at the inlet to the flood flow swale spillway. On the day of inspection, September 19th, water level in storage was at normal elevation, that is at the crest of the upper stoplog. The toe area of the embankment was reasonably dry and no movement of any water was noted.

The spillway shaft and the tube thru the embankment were okay. The riprap paving at the tube outlet was satisfactory and there was no evidence of seepage around the outside of the tube.

The top of the dam embankment is somewhat sandy and a bit soft in places. The condition is satisfactory for the present time. Periodic inspections will continue at this dam and, if a suitable improvement in turf cover does not occur as a result of the present fall and next spring growing season, the owner will be advised to fertilize, reseed and, if necessary, reloam the weak areas.

In the opinion of the undersigned, the dam is safe.

**TIGHE
& BOND CONSULTING ENGINEERS**

2.

Factory Hollow Dam

The leak at the face on the left side of the dam and at the natural abutment rock has increased in quantity and appears to have increased in surface area. The leakage is not dangerous however since it is occurring entirely thru the joints of the stone masonry and at the point where the stone masonry abutts relatively solid natural valley ledge. An examination of the face proper shows no sign of bulging or displacement.

The toe area just down stream of the masonry wall of the dam is in fair condition but in another year or two this area will undoubtedly need mass concrete to prevent any deep erosion and undercutting of the toe of the dam.

The crest of the dam was noted to be satisfactory. It is o.k. as to alignment and grade. There were no flashboards on the crest and water level in storage was at crest elevation.

Though the dam is in need of attention, the structure is safe. Eventually the leakage may require correction to prevent lowering of the pond level in time of dry weather summer flow conditions. This work could be accomplished by plugging the joints of the masonry on the upstream side of the dam.

An inspection of all dams in Amherst will be made again during the summer of 1970 and at that time a recommendation no doubt will be made that the owner take steps to place mass concrete in the bed of the stream at the toe of the masonry wall forming the dam.

Respectfully submitted,

Tighe & Bond, Inc.

George H. McDonnell
George H. McDonnell
Chief Engineer E.E.

GHH/ekd

GEORGE H McDONNELL
PHILIP W SHERIDAN
EDWARD J BAYON

TIGHE & BOND

CONSULTING ENGINEERS

CIVIL, SANITARY AND ELECTRICAL ENGINEERING
INVESTIGATIONS, REPORTS, PLANS AND SPECIFICATIONS
SUPERVISION OF CONSTRUCTION AND OPERATION

BOWERS AND PEQUOT STREETS
HOLYOKE, MASSACHUSETTS
TEL. JEFFERSON 3-3991

H-36 Amherst
February 12, 1970

The Honorable the Board of County Commissioners
Hampshire County Courthouse
Northampton, Massachusetts

Re: Factory Hollow Dam
North Amherst

Gentlemen:

On Wednesday afternoon, February 11th, the undersigned made an inspection of the above subject dam. Water was overflowing the entire crest of the dam and conditions appeared to be satisfactory.

On the downstream face of the right abutment area there was some ice cover indicating leakage thru the abutment stones. Leakage thru the masonry of the dam has been observed and reported in the past. This leakage does not endanger the structure.

A large quantity of water was overflowing the crest. Though the crest of the dam could not be examined, the manner in which water passed over the crest indicated that the crest was on suitable grade and alignment. There appeared to be no damage to the crest from the heavy overflow of the recent rainstorm.

Because of the high rate of flow it was not possible to examine the toe of the dam in the bed of the stream.

All dams in the Town of Amherst are scheduled for inspection during 1970. This work will be done in the summer when stream flow will be low and thorough examinations can be made at areas such as toe areas in the bed of streams at overflow dams.

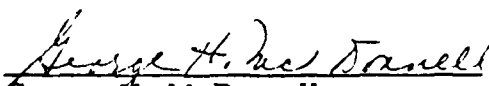
**TIGHE
& BOND CONSULTING ENGINEERS**

-2-

Based upon conditions as observed at the Factory Hollow Dam on Wednesday afternoon, February 11th, the structure was in satisfactory condition and was safe.

Respectfully submitted,

Tighe & Bond, Inc.


George H. McDonnell
Chief Engineer

GHM/amd

INSPECTION REPORT - DAMS AND RESERVOIRS

(1.)

LOCATION:

~~XXXX~~ Town Amherst . County Hampshire . Dam No. 2-8-8-4 .

Name of Dam Factory Hollow Dam "Puffer's Pond" .

Topo Sheet No. 11B . Mass. Rect. Coordinates: N 517,400 , E 324,600 .

Inspected by: R.C. Salls, P.E. On Dec. 14, 1972 . Date Last Inspection 2-11-70 .

(2.)

OWNER/S: As of Dec. 14, 1972

per: Assessors X , Reg. of Deeds _____ , Prev. Insp. _____ , Per. Contact X .

1. Conservation Commission, Town of Amherst, Town Hall, Amherst, Mass. 01002
Name St. & No. City/Town State Tel. No.

2. _____
Name St. & No. City/Town State Tel. No.

3. _____
Name St. & No. City/Town State Tel. No.

(3.)

CARETAKER: (if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

Mr. Allen Torrey, Town Manager, Town Hall, Amherst, Mass. 01002
Name St. & No. City/Town State Tel. No.

(4.)

DATA:

No. of Pictures Taken See note below Sketches See description of dam.

Plans, Where None located.

Pictures taken of upstream face etc. taken in 1947 during repairs available in Town Engineer's Office. Pictures taken Dec. 7, 1972 by Department's photographer for DPW

(5.)

News show leaks.

DEGREE OF HAZARD: (if dam should fail completely)*

1. Minor _____ .

3. Severe _____ .

2. Moderate _____ .

4. Disastrous X _____ .

Comments: There is an apartment complex about 3 - 400 Ft. downstream of dam .

*This rating may change as land use changes (future development).

(6.)

OUTLETS: OUTLET CONTROLS AND DRAWDOWN

No. 1 Location and Type: 45" diam. steel plate penstock about 20 Ft. from north end of dam.

Controls - -, Type: Supposed to be blocked by concrete but some water is flowing through.

Automatic . Manual . Operative Yes , No X.

Comments: Lower end is plugged and there is an opening cut in bottom of conduit about 20 - 30 Ft. downstream of dam.

No. 2 Location and Type: Drawdown sluiceway - about 24' + from north end dam about 8' - 10 below crest spillway - 2 1/2 Ft. sq.

Controls - -, Type: Old wooden slide gate supposed to have been blocked with concrete - some water flowing from opening.

Automatic . Manual . Operative Yes , No X.

Comments: Part of timber of gate mechanism visible in water.

No. 3 Location and Type: Near center of spillway at toe of dam - appears to be 12 inch pipe.

Controls X, Type: This is supposed to have been blocked by concrete plug in 1947.

Automatic . Manual . Operative Yes , No X.

Comments:

Drawdown present Yes X, No . Operative Yes , No X.

Comments: See #2 and 3 above - In Nov. '72 Town tried to open gates - unable to drain pond.

(7.)

DAM UPSTREAM FACE: Slope 1 to 1, Depth Water at Dam 12' ±.

Material: Turf . Brush & Trees . Rock fill . Masonry X. Wood .

Other Appears to be stone masonry with concrete face.

Condition: 1. Good . 3. Major Repairs X ?.

2. Minor Repairs . 4. Urgent Repairs .

Comments: Since numerous leaks can be seen on downstream face, it would appear that concrete cover is broken and allows water to pass.

(8.)

DAM DOWNSTREAM FACE: Slope Vertical.

Dry
stone

Material: Turf . Brush & Trees . Rock fill . Masonry X. Wood .

Other

Condition: 1. Good . 3. Major Repairs X.

2. Minor Repairs . 4. Urgent Repairs .

Comments: Visible leaks around area of penstock and in low water through stone masonry and below spillway. These leaks very noticeable at south end.

9.

EMERGENCY SPILLWAY: Available X. Needed _____.Height Above Normal Water 1 Ft.Width 106 Ft. Height 5 Ft. Material Concrete and ledge.

Condition: 1. Good _____. 3. Major Repairs _____.

2. Minor Repairs X. 4. Urgent Repairs _____.Comments: Abutments of dam are natural ledge rising 15 - 20 ft. above crest spillway, but top of dike on north side of north ledge outcropping is only about 3 ft. above crest.

10.

WATER LEVEL AT TIME OF INSPECTION: 1/4 Ft. Above X. Below _____.Top Dam _____ F.L. Principal Spillway XOther There is an earth dike north of ledge abutment at north end of dam - about 100 ft. north with its top about 4 - 5 ft. above spillway crest elevation.Normal Freeboard 1 1/2 Ft.

11.

SUMMARY OF DEFICIENCIES NOTED:

Growth (Trees and Brush) on Embankment 6" tree growing at toe dam near north end.Animal Burrows and Washouts None foundDamage to Slopes or Top of Dam Leaks through stone masonryCracked or Damaged Masonry See aboveEvidence of Seepage None seenEvidence of Piping YesLeaks YesErosion NoneTrash and/or Debris Impeding Flow NoClogged or Blocked Spillway NoOther (1) Both drawdowns inoperative - gates appear to be concreted over.(2) Public has free access to crest of dam.

(12.)

OVERALL CONDITION:

1. Safe_____.
2. Minor repairs needed_____.
3. Conditionally safe - major repairs needed_____.
4. Unsafe X_____.
5. Reservoir impoundment no longer exists (explain)
Recommend removal from inspection list_____.

(13.)

REMARKS AND RECOMMENDATIONS: (Fully Explain)

This is a very old stone masonry spillway dam appearing on an 1855 map of Hampshire County. It was formerly used to provide power to mills on the west side of Mill Street where an apartment complex is now. The old sheet steel penstock at the north end of the dam is still in place but is plugged at Mill Street and has a large rectangular hole cut in its bottom about 25 to 30 feet downstream of the dam allowing water to flow into the brook.

There is a considerable flow from this hole although the upper end of the penstock is supposed to have been blocked with concrete. About 3 to 4 feet south of the penstock and inaccessible because of the water flowing over the spillway, there is a drawdown sluiceway about $2\frac{1}{2}$ feet square. There is about 2 inches of water flowing from this sluiceway which also is supposed to be blocked by concrete. The headworks for both the penstock and sluiceway have been removed except for a concrete pier on the shore and some timbers of the slide gate frames which can be seen below the water. A diver reported that some of the old wooden bulkhead or gate was exposed.

There are numerous leaks from the downstream face of the dam particularly noticeable around and adjacent to the penstock and before the onset of the full runoff in an area about 10 to 20 feet from the south end and 5 to 15 feet below the crest. Also looking under Nappe, what appeared to be small leaks are visible over the rest of the face. The industrial user of the water complained last summer that the extent of the leaks restricted the available water.

The masonry appears to be dry stone. The face of the dam is true with no noticeable bulges or misplaced stones. The spillway crest, capped with concrete is level and the cap seems to be free of cracks. The slope of upstream face is somewhat steep for the height. The top is $5\frac{1}{2}$ ft. wide and the back face has a 1 to 1 slope. The entire structure seems to be founded on ledge.

RCS/sd/vk

The Town is in the process of rehabilitating this dam but has not yet been able to draw down the water. The Town Engineer is making a survey of the dam and its site and has located pictures taken of the back side of the dam in 1947 when repairs were made.

This dam is classified as unsafe by the District because the existence of leaks could indicate serious and widespread deterioration because the water cannot be drawn down for control, inspection, and repairs, and heavy development along the Mill River below would be damaged in the event of a failure.

This inspection was made in the presence of the Town Engineer, Mr. James A. Smith, who supplied much of the information.

DESCRIPTION OF DAM

DISTRICT 2.

Submitted by R.C. Salls, P.E. Dam No. 2-8-8-4

Date December 14, 1972 ~~LDL~~ Town Amherst

Name of Dam Factory Hollow
"Puffer's Pond" Dam

1. Location: Topo Sheet No. 11B Mass. Rect. Coordinates N 517,400 E 324,600

Provide $8\frac{1}{2}$ " x 11" in clear copy of topo map with location of Dam clearly indicated.

On Mill River in North Amherst, just east of Mill St. about 350 feet northerly from State Street - southerly 200 feet from Summer Street.

2. Year built Unk. - 1860 † Year/s of subsequent repairs 1947
* See note

3. Purpose of Dam: Water Supply _____ Recreational X
Irrigation _____ Other Old mill dam now owned by Conservation Commission - al source water for industrial us

4. Drainage Area: 15 $\frac{1}{2}$ sq. mi. _____ acres.
Type: City, Bus. & Ind. _____ Dense Res. _____ Suburban 1 $\frac{1}{2}$ Rural, Farm 9 $\frac{1}{2}$
Wood & Scrub Land 90% Slope: Steep 80% Med. 20% Slight 1

5. Normal Ponding Area: 10 Acres; Ave. Depth 8 Ft.
Impoundment: 26 Million gals.; 80 acre ft.
Silted in: Yes X No _____ Approx. Amount Storage Area 40 $\frac{1}{2}$

6. No. and type of dwellings located adjacent to pond or reservoir _____
i.e. summer homes etc. 2 year round houses immediately on pond.
Industrial site draws water from pond.

7. Dimensions of Dam: Length 106 Ft. Max. Height 28 $\frac{1}{2}$ Ft.
Freeboard 1 Ft. See note.
Slopes: Upstream Face 1 to 1
Downstream Face Vertical
Width across top 4 Ft.

D.M NO. 2-8-8-4

8.

Classification of Dam by Material:

Earth _____ Conc. Masonry _____ Stone Masonry X
Timber _____ Rockfill _____ Other _____

8A.

Dam Type Gravity X Straight X Curved, Arched _____ Other _____
Spillway dam.

9.

A. Description of present land usage downstream of dam:

80 - 85 % rural; 15 - 20 % urban Immediately downstream

B. Is there a storage area or flood plain downstream of dam which could accommodate the impoundment in the event of a complete dam failure. yes X no _____

Apartments on flood plain - 3 - 400 Ft. downstream.

C. Character Downstream Valley: Narrow _____ Wide X Developed 20%
Rural 80% Urban 20%

10.

Risk to life and property in event of complete failure.

* No. of people 300

No. of homes 50 + 5 apartment complexes.

No. of businesses 1 General business block - 1 Auto dealership -
1 Contractor's yard.

No. of industries 1 Type L

No. of utilities 3 Type Pole lines
2 sewer mains
1 water main

Railroads None Immediately below.

Other dams #2-8-117-3 - Lake Warner in Hadley

Other Route 116, Route 63, Route 47.

11.

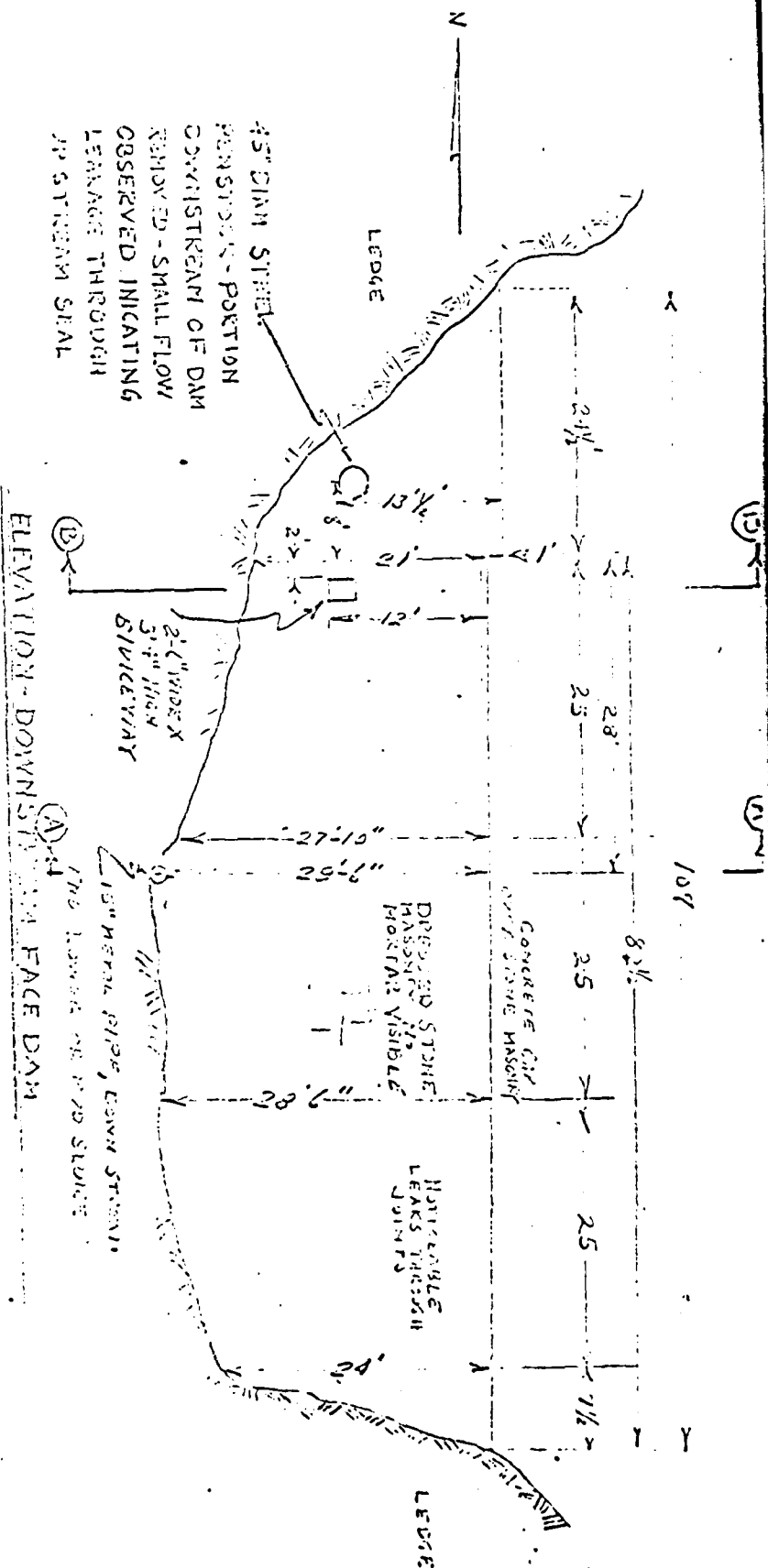
Attach Sketch of dam to this form showing section and plan on 8 $\frac{1}{2}$ "x11" sheet.

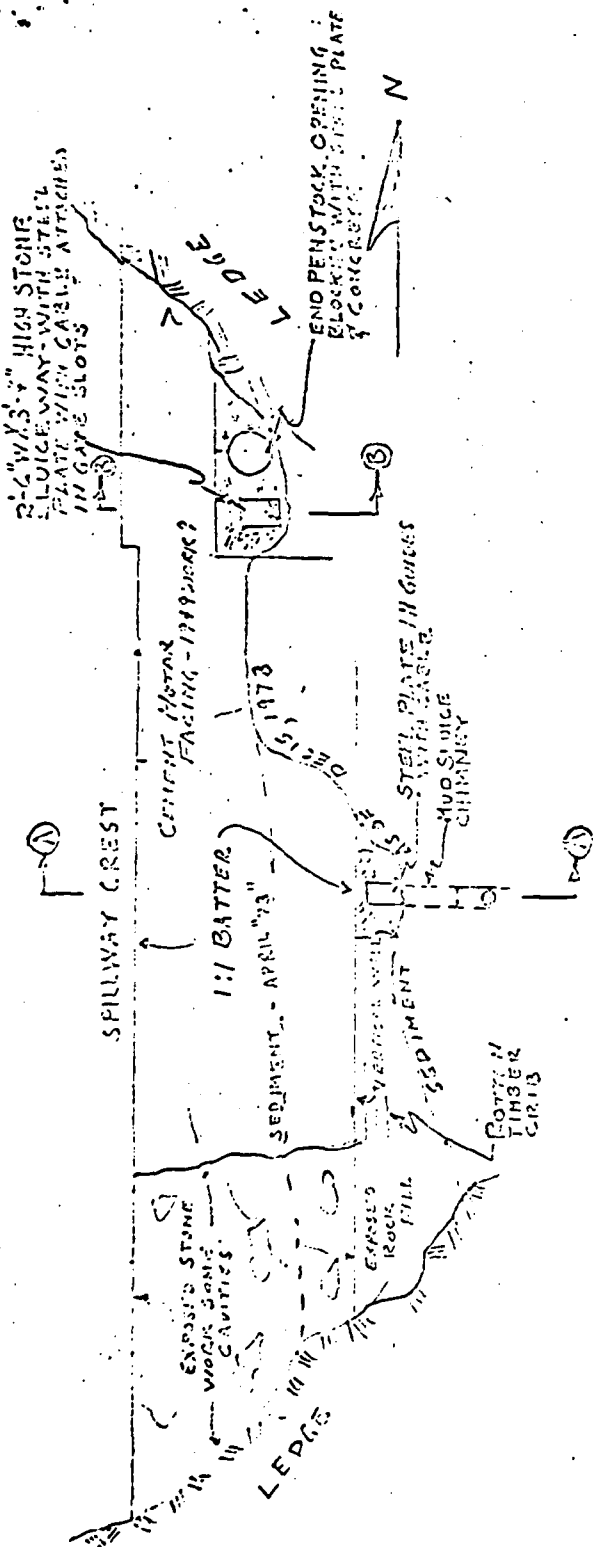
* Large number people affected due to existence of large garden apartment complexes downstream.

RCS/vk

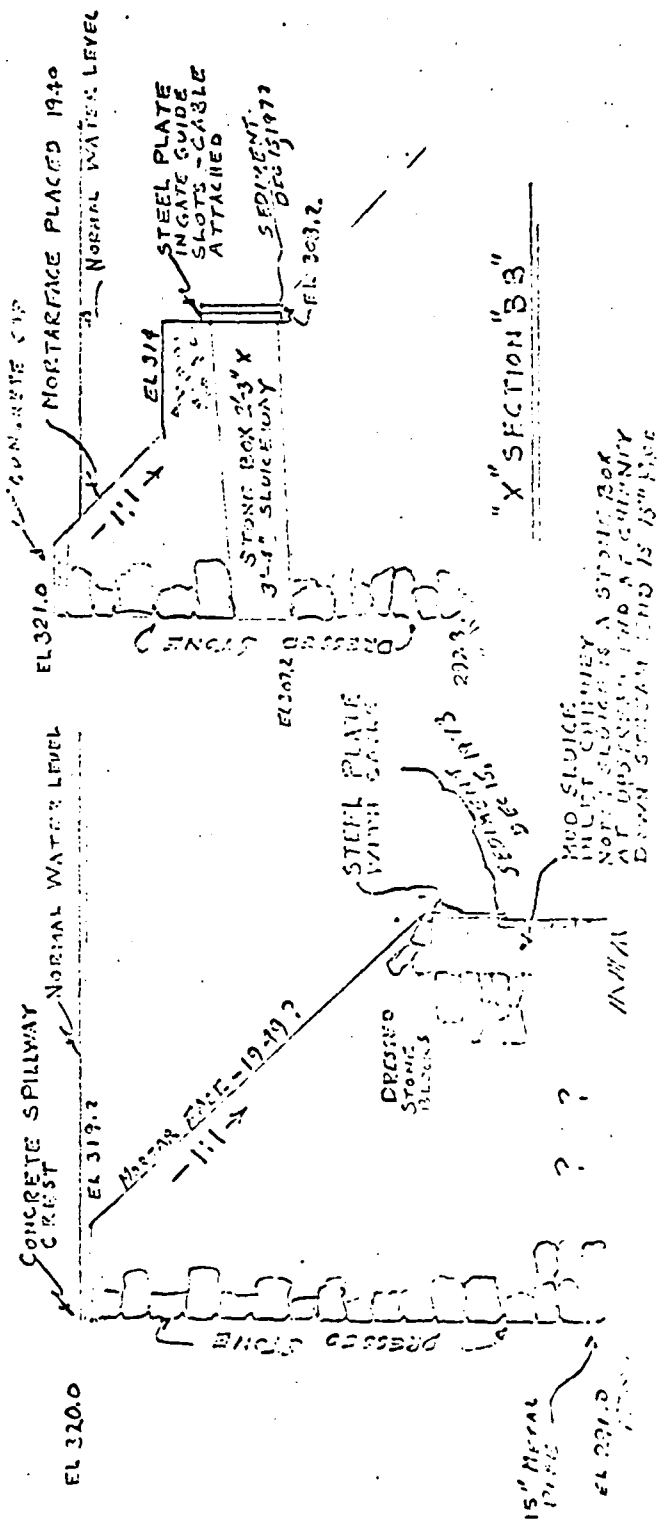
Attachments About 2 - 300 Ft. N. Nw'ly. dam there is a dike about 6 Ft. high - 100 Ft.
Longs Plan long with top about 3 - 4 Ft. above water. Dike No. 2-8-8-4A.
Sketches

JOHN MO 2-4-2-1
FACTORY WORKING DAY





ELEVATION - UPSTREAM FACE DAM



SKETCHES SHOW INFORMATION OBTAINED BY TOWN ENGINEER WHEN POND DRAIN DOWN DEC. 1973 TO JAN. 1974

INSPECTION REPORT - DAMS AND RESERVOIRS

①

LOCATION:

~~City~~/Town Amherst . County Hampshire . Dam No. 2-8-8-4A .

Name of Dam Dike for Factory Hollow Pond .

Mass. Rect.
Topo Sheet No. 11B . Coordinates: N 517.700 , E 324.700 .

Inspected by: R.C. Salls, P.E., On Dec. 14, 1972 . ^{Date} Last Inspection New Listing

②

OWNER/S: As of Dec. 18, 1972

per: Assessors X , Reg. of Deeds _____ , Prev. Insp. _____ , Per. Contact _____
From Town Engineer

1. George A. Cavanaugh, Jr., 64 Mill St., Amherst, Mass. 413-549-0611
Name St. & No. City/Town State Tel. No.

2. _____
Name St. & No. City/Town State Tel. No.

3. _____
Name St. & No. City/Town State Tel. No.

③

CARETAKER: (if any) e.g. superintendent, plant manager, appointed by
absentee owner, appointed by multi owners.

Same
Name St. & No. City/Town State Tel. No.

④

DATA:

No. of Pictures Taken - - . Sketches See Description .
Plans, Where None located .

⑤

DEGREE OF HAZARD: (if dam should fail completely)*

1. Minor _____ . 3. Severe X _____ .

2. Moderate _____ . 4. Disastrous _____ .

Comments: As dike appears to be built on ledge and impounds only the top 3 - 4
feet of water its failure would not completely drain pond.

*This rating may change as land use changes (future development).

6.

OUTLETS: OUTLET CONTROLS AND DRAWDOWN

No. 1 Location and Type: See Inspection Report for Dam No. 2-8-8-4.
Controls____, Type:_____
Automatic____. Manual____. Operative Yes____, No____.
Comments:_____

No. 2 Location and Type:_____
Controls____, Type:_____
Automatic____. Manual____. Operative Yes____, No____.
Comments:_____

No. 3 Location and Type:_____
Controls____, Type:_____
Automatic____. Manual____. Operative Yes____, No____.
Comments:_____

Drawdown present Yes____, No____. Operative Yes____, No____.
Comments:_____

7.

DAM UPSTREAM FACE: Slope 2:1, Depth Water at Dam 6 to 8.

Material: Turf X. Brush & Trees____. Rock fill____. Masonry____. Wood____.
Other_____

Condition: 1. Good X. 3. Major Repairs____.
2. Minor Repairs____. 4. Urgent Repairs____.

Comments:_____

8.

DAM DOWNSTREAM FACE: Slope 2:1 or less.

Material: Turf X. Brush & Trees____. Rock fill____. Masonry____. Wood____.
Other_____

Condition: 1. Good X. 3. Major Repairs____.
2. Minor Repairs____. 4. Urgent Repairs____.

Comments: Dike at top natural slope.

9. EMERGENCY SPILLWAY: Available X. Needed _____. See Inspection Report on Dam No. 2-8-8-4

Height Above Normal Water _____ Ft.

Width _____ Ft. Height _____ Ft. Material _____.

Condition: 1. Good _____. 3. Major Repairs _____.

2. Minor Repairs _____. 4. Urgent Repairs _____.

Comments: _____

10. WATER LEVEL AT TIME OF INSPECTION: 3-4 Ft. Above _____. Below X.

Top Dam X F.L. Principal Spillway

Other _____.

Normal Freeboard 3-4 Ft.

11. SUMMARY OF DEFICIENCIES NOTED:

Growth (Trees and Brush) on Embankment Some trees on natural ground near dike.

Animal Burrows and Washouts None observed.

Damage to Slopes or Top of Dam None observed.

Cracked or Damaged Masonry N/A.

Evidence of Seepage None seen.

Evidence of Piping None seen.

Leaks None seen.

Erosion None seen.

Trash and/or Debris Impeding Flow No.

Clogged or Blocked Spillway No.

Other _____.

(12.)

OVERALL CONDITION:

1. Safe X.
2. Minor repairs needed_____.
3. Conditionally safe - major repairs needed_____.
4. Unsafe_____.
5. Reservoir impoundment no longer exists (explain)
Recommend removal from inspection list_____.

(13.)

REMARKS AND RECOMMENDATIONS: (Fully Explain)

This is a low earth dike located on the edge of Factory Hollow Pond about 150 to 200 feet north and 100 feet east of the main dam. It closes a low area between the ledge outcropping which forms the north abutment of the dam and higher ground to the north. It averages about 3 to 4 feet above the natural ground on the downstream side, has 2:1 slopes and is about 8 feet wide on top. The grade of the top is level and there is a growth of turf over the entire embankment.

RCS/sd/vk

DESCRIPTION OF DAM

DISTRICT 2.

Submitted by R.C. Salls, P.E. Dam No. 2-8-8-4A

Date December 14, 1972 ~~XXXX~~ Town Amherst

Name of Dam Factory Hollow DiKE

1. Location: Topo Sheet No. 11B Mass. Rect. Coordinates N 517,700 E 324,700

Provide $8\frac{1}{2}$ " x 11" in clear copy of topo map with location of Dam clearly indicated.

About 300 ft. easterly from Mill Street in North Amherst, about 100 ft. north of bridge over Mill River. Behind No. 64 Mill Street.

2. Year built Unknown Year/s of subsequent repairs Unknown

3. Purpose of Dam: Water Supply _____ Recreational _____
Irrigation _____ Other Old Mill Pond - See Dam #2-8-8-4

4. Drainage Area: 15 $\frac{1}{4}$ sq. mi. _____ acres.
Type: City, Bus. & Ind. _____ Dense Res. _____ Suburban 1% Rural, Farm 9%
Wood & Scrub Land 90% Slope: Steep 80% Med. 20% Slight _____

5. Normal Ponding Area: 10 Acres; Ave. Depth 8 Ft.
Impoundment: 26 Million gals.; 80 acre ft.
Silted in: Yes X No _____ Approx. Amount Storage Area 40

6. No. and type of dwellings located adjacent to pond or reservoir _____
i.e. summer homes etc. 2 year round houses immediately on pond.

7. Dimensions of Dam: Length 100 Ft. Max. Height 6 Ft.
Freeboard 3 to 4 Ft.
Slopes: Upstream Face 2:1
Downstream Face 2:1
Width across top 6 - 8 Ft.

8.

Classification of Dam by Material:

Earth X Conc. Masonry _____ Stone Masonry _____
 Timber _____ Rockfill _____ Other _____

8A.

Dam Type Gravity X Straight X Curved, Arched _____ Other _____

9.

A. Description of present land usage downstream of dam:

80 - 85 % rural; 15 - 20 % urban - owner house immediately below

B. Is there a storage area or flood plain downstream of dam which could accommodate the impoundment in the event of a complete dam failure. yes X no _____

Apartment across Mill St.

C. Character Downstream Valley: Narrow _____ Wide _____ Developed _____
 Rural _____ Urban _____

10.

Risk to life and property in event of complete failure.

No. of people 15 - 20

No. of homes 1 plus apartments "eight family units" - immediately below

No. of businesses None

No. of industries None Type _____

No. of utilities 3 Type Pole Lines
2 sewer mains - 1 water

Railroads None

Other dams #2-8-117-3 - Lake Warner in Hadley

Other Since less water would be released by failure of dike than dam estimated risk is considerable less.

11.

Attach Sketch of dam to this form showing section and plan on $8\frac{1}{2}$ "x11" sheet.

RCS/vk

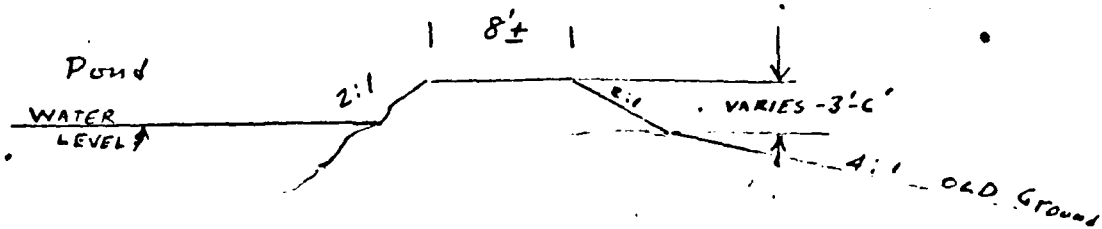
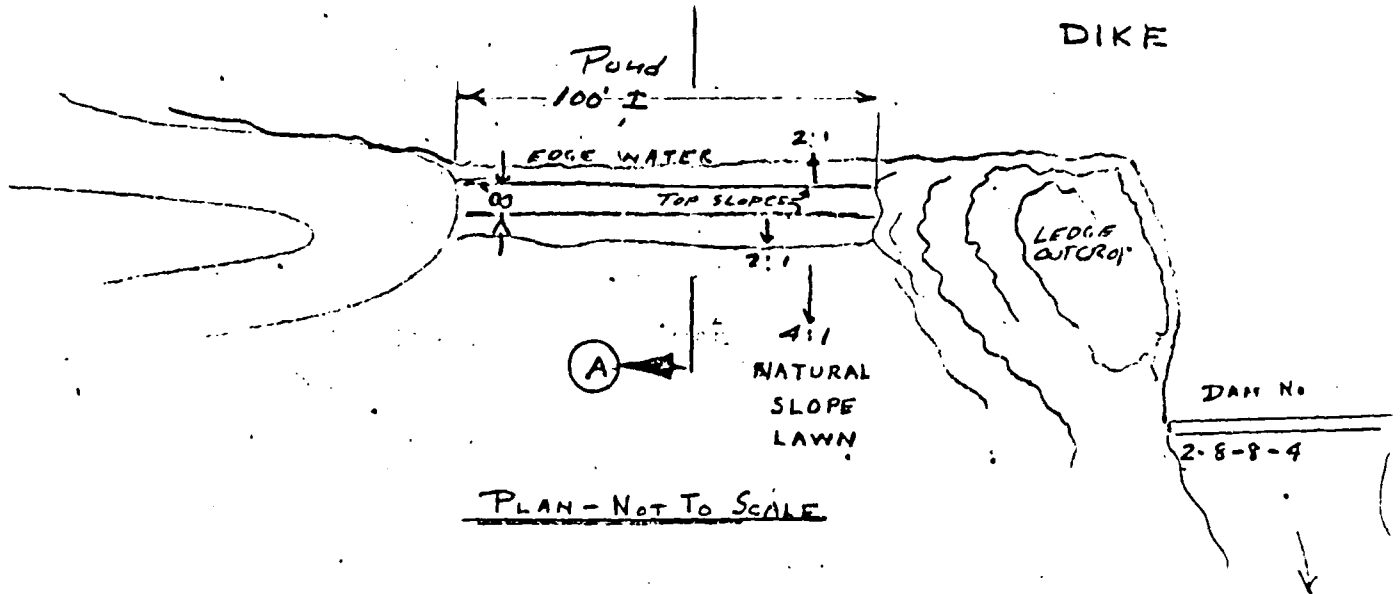
Attachments

Locis Plan

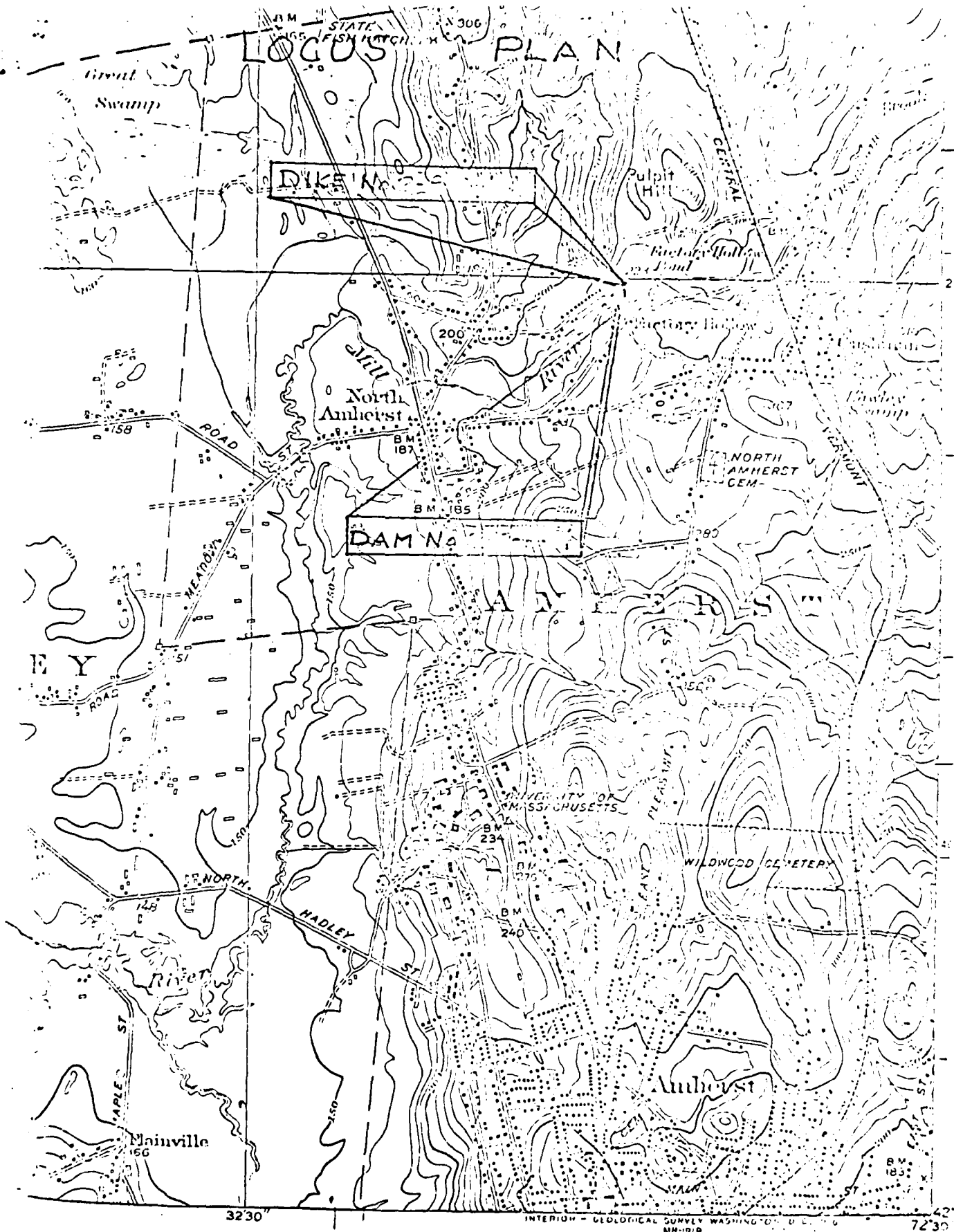
Sketches

SKETCHES
NOT TO SCALE

DAM No 2-8-8-4A
FACTORY HOLLOW
DIKE



X SECTION A A



ROAD CLASSIFICATION

113

B-29

Heavy-duty

Medium-duty

FACTORY HOLLOW DAM AND DIKE

TIGHE & BOND

CONSULTING ENGINEERS
ENVIRONMENTAL SPECIALISTS

INVESTIGATIONS, REPORTS, PLAN AND SPECIFICATION
SUPERVISION OF CONSTRUCTION AND OPERATION

ASSOCIATES

MICHAEL R. FINN
GERARD L'HEUREUX
EDWARD A. MOE
DENNIS A. TRIPP

LABORATORY DIRECTOR
GARY R. SWANSON

A-147-00
June 11, 1974

BOWERS AND PEQUOT STREETS
HOLYOKE, MASSACHUSETTS 01040
TEL 513-533-3991

Mr. Allen L. Torrey, Town Manager
Town of Amherst
Town Office
Amherst, Massachusetts 01002

Dear Sir:

Re: Factory Hollow Dam
North Amherst, Massachusetts

On Friday morning of last week, June 7th, the metal slide plate forming the gate at the upstream end of the stone box sluiceway, at the above-subject dam, was set in place by personnel of the Amherst Department of Public Works. By mid-morning the opening was closed and at about 10:30 a.m. there were approximately 3' of water backed up forming a small pond.

An examination was made of the front face of the dam before the sluiceway was closed and again $\frac{1}{4}$ hour, more or less, following the closure of the sluiceway. Neither of these two inspections showed the presence of leakage on the dry or downstream face of the stone masonry dam.

As the water in storage increased in elevation to the point about 3' above the invert of the upstream end of the sluiceway, the beginning of water seepage was observed on the downstream face of the lower portion of the stone masonry dam near the left abutment. Water was trickling from a dry masonry joint near the base of the dam a short distance out from the rock ledge of the left abutment.

A reinspection of the dam was made at 3:00 p.m. At that time the level of stored water was 6" above the top of the concrete masonry that forms the entrance block of the sluiceway on the pondside face of the dam. From the

A DIVISION OF RIPPICAN CONSULTANTS INTERNATIONAL

record drawing of the dam, water level at 3:00 p.m. was $6\frac{1}{2}'$ above the invert of the sluiceway. Thus, head of water on the dam had increased about $3\frac{1}{2}'$ since mid-morning.

An examination of the face of the dam at 3:00 p.m. showed the existence of three separate leaks at the masonry toe of the dam in the central area of the structure at and just above stream bed level. The small leak at the bottom left face of the dam observed at 10:30 a.m. had now spread to a number of adjacent joints and water was discharging over a relatively large area of the dam face about equal in size to the area of leakage observed in recent years whenever water was ponded by the dam at or close to spillway crest elevation.

Though the water discharging from the face of the dam at the lower left trickled and seeped from a number of joints, leakage at the base of the dam, near the central section, squirted out from the stone face as a result of pressure build-up within joints and voids of the dam.

A third inspection was made at 8:30 p.m. on Friday evening. At that time the elevation of the surface of the water stored by the dam had increased to a point about 4' below the spillway crest. This head was 9' above the sluiceway invert and $2\frac{1}{2}'$ higher than the head at 3:00 p.m.

Leakage at the face of the dam was observed in the same general areas as noted at 3:00 p.m. However, the rate of leakage had increased due to the higher head of stored water.

From the information collected and the observations made between mid-morning and 8:30 p.m. on Friday, June 7th, it can be concluded that the majority of leakage through the stone masonry dam enters the dam from an elevation just above the sluiceway invert up to a point of from 6' to 7' below spillway crest elevation. This represents an area on the wet face of the dam with a $6\frac{1}{2}'$ vertical dimension for the full width of the wet face.

No doubt additional leaks occur above the upper limit of the area just mentioned. However, it would appear that the majority of discharge points of seepage at the downstream face of the dam receive water from the described area of the upstream face.

A fourth examination of the dam was made early Monday morning, June 10th, and at that time a thin sheet of water overflowed the entire spillway crest of the dam. The downstream face of the dam and the toe area was visible through the thin sheet of falling overflow water. It was noted that the various leaks and

seepage areas observed on Friday evening when water in storage was still 4' below spillway crest, had changed very little except for the fact that in some instances the extra head of water resulted in higher leakage rates and increased pressure discharges.

Through the sheet of falling water it was noted that there were a number of small leaks through open joints of the stone masonry at elevations along the top quarter of the dam. These apparently developed when full head occurred as a result of the pond behind the dam filling to spillway elevation.

Many of the voids on the upstream face of the dam recently were filled and plugged with concrete and mortar, when stored water was low, in an attempt to reduce seepage through the dam. However, these temporary repairs did little to reduce the quantity and the area of leakage observed in recent years when the pond has been full.

The record drawings of the dam prepared by the Town Engineering Department show that the front face of the dam at about the center of the brook is 27', more or less, in height. Leakage emerging from the toe of the dam as reported hereinbefore would indicate that water entering the upstream face not only flows in a somewhat horizontal or downstream direction through the masonry but vertically as well, a distance of 15' or more to emerge as an actual pressurized toe area discharge. This type of leakage could only occur if many voids and channels exist within the stone masonry structure.

The downstream face of the dam is made up of dry joints and with varying sizes and shapes of miscellaneous stone. There is no data or information available as to the interior construction of the dam or the foundation on which it has been built. The stream bed at the downstream toe area is sandy, bouldery and there is evidence of ledge in portions of the toe area. The abutments have been built against natural valley ledge.

In order to control leakage through the dam it would appear that entry of water from the pond must be prevented at and within the wet face area of the structure. Possible leakage thru the seams of abutment area ledge must also be considered. Normally to seal a dam and prevent water leakage thru the structure, the upstream face and abutment areas are cleaned and then either sealed with a membrane type construction or covered with a water tight application of a sand, cement and water mixture applied by a gun using air pressure (Gunite).

In my opinion before any consideration can be given to the type of surface treatment that should be applied to the upstream face of the dam and the related abutment areas, the interior of the stone masonry structure should be investigated by drilling. The drill holes would be installed in such a manner that the upstream 1/3 to 1/2 of the mass forming the dam could be investigated to determine whether or not pressure cement grouting can be applied to fill the various open joints and voids of the masonry.

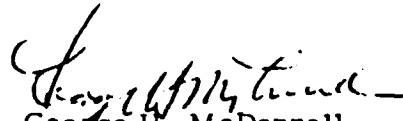
All voids and open joints just at and under the upstream face of the dam would be filled so that water could not enter and pass through the dam. The upstream face and abutment areas would then be gunited. There would be little need to bother with grouting and cementing the downstream portion of the dam. As of this writing it would seem to me that the downstream portion should remain in its present condition so as to allow for the release of any water that does make its way into the dam.

I will contract drilling companies to determine the probable cost of direct vertical boring and angle boring into the dam for the purpose of recovering cores to be used in studying the dam interior. The drill holes would be laid out in such a manner that they could then be used for any grouting work. A few holes would be drilled vertically from the spillway crest to determine foundation conditions at the front one-third portion of the dam. These holes probably would never be used for grouting purposes.

I expect that during the summer I will be able to put together a fairly close cost estimate for all the work of investigating and repairing the dam to meet Massachusetts Waterways Division requirements. The probable cost for grouting within the dam could not be included until after our boring investigation. Before engaging a boring contractor to do the work I will get a cost estimate and review this planned expenditure with you.

Very truly yours,

TIGHE & BOND


George H. McDonnell
Chief Engineer

GHM/mm

American Drilling & Boring Co., Inc.

100 WATER STREET EAST PROVIDENCE, R. I.

TO Tighe & Bond ADDRESS Holyoke, Mass.
PROJECT NAME Factory Hollow Dam LOCATION Amherst, Mass.
REPORT SENT TO above PROJ. NO. 52138
SAMPLES SENT TO taken at site OUR JOB NO. 52138

DATE 11/14/74
HOLE NO. #1
LINE & STA.
OFFSET
SURF. ELEV.

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR	Date	Time
At <u></u> after <u></u> Hours	Type <u>NW/BW</u>	<u></u>	<u>NX-BX</u>	START <u>11/14/74</u>	<u></u>	<u>8</u>
At <u></u> after <u></u> Hours	Size I.D. <u>3"/2 1/2"</u>	<u></u>	<u></u>	COMPLETE <u>11/18/74</u>	<u></u>	<u>8</u>
	Hammer Wt. <u>Drilled</u>	<u></u>	<u></u>	TOTAL HRS. <u></u>	<u></u>	<u></u>
	Hammer Fall <u></u>	<u></u>	<u>BIT</u>	BORING FOREMAN <u>Al Hittaker</u>	<u></u>	<u></u>
		<u></u>	<u>dia</u>	INSPECTOR <u></u>	<u></u>	<u></u>
		<u></u>	<u></u>	SOILS ENGR. <u></u>	<u></u>	<u></u>

LOCATION OF BORING:

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler			Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE		
				From 0-6	To 6-12	To 12-18				No	Pen	R
		0'-1.5'	C					0'	Top of Dam Slope	C1	1.50	
		1.5'-4.5'	C						Lost water as soon as cement was penetrated	C2	3.5	
		4.5'-8.5'	C						Boulder not larger than 2' down to 3" cobble w/finer material washed away	C3	4' 1.	
		8.5'-10'	C						Continuous voids between Boulders	C4	1.51	
		10'-16'	C							C5	6' 3.	
		16'-21'	C							C6	5' 2.	
		21'-30'	C					20'	Same as above with some fine gravel mixed in	C7	9' 2.	
		30'-33'	C					29'	Top of Rock	C8	3' 0'	
								33'	Gray MICA SCHIST			
									Bottom of Boring - 33'			

GROUND SURFACE TO <u>11'</u>		USED <u>3"</u>	CASING: THEN <u>2" casing to 30' & BA Core</u>
Sample Type D=Dry C=Cored W=Washed UP=Undisturbed Piston TP=Test Pit A=Auger V=Vane Test	Proportions Used trace 0 to 10% little 10 to 20% some 20 to 35%	140 lb Wt. 30" fall on 2" O.D. Sampler Cohesionless Density 0-10 Loose 10-30 Med. Dense 30-50 Dense	SUMMARY: Earth Boring Rock Coring <u>33</u> Samples <u></u>
		Cohesive Consistency 0-4 Soft 30+ Hard 4-8 M/Soft 8-15 Shll	

AMERICAN DRILLING & BORING CO., INC.

100 WATER STREET EAST PROVIDENCE, R. I.

TO Ticco & Bond ADDRESS Nolyoke, Mass.
 PROJECT NAME Factory Hollow Dam LOCATION Anherst, Mass.
 REPORT SENT TO above PROJ. NO. 52138
 SAMPLES SENT TO taken at site OUR JOB NO. 52138

DATE 11/18/74
 HOLE NO. #2
 LINE & STA.
 OFFSET
 SURF. ELEV.

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.	Date	Time
At <u></u> after <u></u> Hours	Type <u>NW/BW</u>	<u>3"/2 1/4"</u>	<u></u>	<u>NX-BX</u>	START <u>11/18/74</u>	
At <u></u> after <u></u> Hours	Size I.D. <u>Drilled</u>	<u></u>	<u></u>	<u>BIT</u>	COMPLETE <u>11/21/74</u>	
	Hammer Wt. <u></u>	<u></u>	<u></u>	<u>dia</u>	TOTAL HRS. <u></u>	
	Hammer Fall <u></u>	<u></u>	<u></u>	<u></u>	BORING FOREMAN <u>A. Chitake</u>	
		<u></u>	<u></u>	<u></u>	INSPECTOR <u></u>	
		<u></u>	<u></u>	<u></u>	SOILS ENGR. <u></u>	

LOCATION OF BORING:

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler			Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc. Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE	
				From 0-6	To 6-12	12-18				No	Per f
		0'-6'	C					0' 0.2'	Top of Dam Slope Concrete	C1	6' 8"
		6'-11'	C						Lost water as soon as cement was penetrated Boulders not larger than 2' down to cobbles of 3" with fine material washed away continuous voids between Boulders	C2	5'
		11'-17'	C							C3	6' 2"
		17'-23.5'	C							C4	6.5'
		23.5'-30'	C					23.5'	Same as above with some finer gravel mixed in	C5	6.5'
								29'	Top of Rock		
		30'-34.5'	C					34.5'	Gray MICA SCHIST	C6	4.5'
									Bottom of Boring- 34.5'		

GROUND SURFACE TO <u>5'</u>		USED <u>3"</u> CASING: THEN <u>2 1/2"</u> casing to 23.5' & BX Core	
Sample Type D=Dry C=Cored W=Washed UP=Undisturbed Piston TP=Test Pit A=Auger V=Vane Test UT=Undisturbed Thinwall	Proportions Used trace 0 to 10% little 10 to 20% some 20 to 35% and 35 to 50%	MOIST Wt. 130" fall on 2" O.D. Sampler Cohesionless Density 0-10 Loose 10-30 Med. Dense 30-50 Dense 50+ Very Dense	Cohesive Consistency 0-4 Soft 30+ Hard 4-8 M/Shift 8-15 Shift 15-30 V-Shift
		SUMMARY Earth Boring <u>32</u> Rock Coring <u>32</u> Samples <u></u>	

INSPECTION REPORT - DAMS AND RESERVOIRS

1. LOCATION:

City/Town Amherst County Hampshire Dam No. 2-8-8-4

Name of Dam Factory Hollow Dam "Puffer's Pond"

Mass. Rect.

Topo Sheet No. 11B Coordinates: N 517,400, E 324,600

Inspected by: Russell C. Salls, P.E. On December 3, Date December 14,
1974 Last Inspection 1972

2. OWNER/S: As of December 14, 1972

per: Assessors _____, Reg. of Deeds _____, Prev. Insp. _____, Per. Contact X

1. Conservation Commission, Town of Amherst, Town Hall, Amherst, Ma. 01002
Name _____ St. & No. _____ City/Town _____ State _____ Tel. No. _____

2. _____
Name _____ St. & No. _____ City/Town _____ State _____ Tel. No. _____

3. _____
Name _____ St. & No. _____ City/Town _____ State _____ Tel. No. _____

3. CARETAKER: (if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

Mr. Allen Torrey, Town Manager, Town Hall, Amherst, Ma. 01002
Name _____ St. & No. _____ City/Town _____ State _____ Tel. No. _____

* See Below.

4. DATA:

No. of Pictures Taken _____. Sketches See description of Dam.
Plans, Where As found December, 1973 plan prepared by Town Engineer. Available from Town. Note: Pictures taken of upstream face, etc. taken during 1971, repairs available in Town Offices. Pictures taken Dec. 7, 1972 by Department's photographer for D. F. J. News. This picture shows leaks.

5. DEGREE OF HAZARD: (if dam should fail completely)*

1. Minor _____ 3. Severe _____

2. Moderate _____ 4. Disastrous X

Comments: There is an apartment complex about 300 - 400 feet downstream of dam.

*This rating may change as land use changes (future development).

* Town Engineer, James Smith, Town Hall, Amherst, Ma. Tel. No. 253-2557

6. OUTLETS: OUTLET CONTROLS AND DRAWDOWN

No. 1 Location and Type: 45" diameter steel plate penstock about 20' from north end of dam. Only portion through dam remains - section downstream has been removed.

Controls , TYPE: See comments.

Automatic . Manual . Operative Yes , No X.

Comments: A steel plate was installed across upstream end when pond was drawn down last winter. Concrete pours over plate to provide permanent closure - small flow through tube observed still flowing.

No. 2 Location and Type: 29' from north end of dam - 2 1/2' sq. cut stone sluiceway. 12' below crest of spillway.

Controls Yes, Type: Steel plate fitted into slots of old slide gate cable attached to raise plate.

Automatic . Manual X. Operative Yes X, No .

Comments: Plate installed when water drawdown last winter.

No. 3 Location and Type: At center bottom of dropwall - mud sluice rectangular stone box upstream end - 15" pipe downstream end.

Controls Yes, Type: Steel plate fitted into slots where old wood barrier was removed. Cable attached to raise plate.

Automatic . Manual X. Operative Yes X, No .

Comments: Plate installed when water was drawdown last winter - upstream end sluice has stone chimney.

Drawdown present Yes X, No . Operative Yes X, No .

Comments: See No's. 2 and 3 above.

7. DAM UPSTREAM FACE: Slope , Depth Water at Dam 8'-10' water over 1'-10' silt.

Material: Turf . Brush & Trees . Rock fill . Stone . Masonry X. Wood .

Other Mortar plaster over upper portion of stone masonry - apparently placed in 1949.

Condition: 1. Good . 3. Major Repairs X.

2. Minor Repairs . 4. Urgent Repairs .

Comments: At bottom of stone masonry on toe of slope. Rotten timber crib found by Town Engineer - could be base of dam. Some breaks in mortar cover on back of dam. Cavities and rotten mortar in southerly quarter of dam.

8. DAM DOWNSTREAM FACE: Slope Vertical.

Material: Turf . Brush & Trees . Rock Fill . Dressed Stone . Masonry X. Wood .

Other .

Condition: 1. Good . 3. Major Repairs X.

2. Minor Repairs . 4. Urgent Repairs .

Comments: Considerable leakage from joints in stone masonry - mainly in area of southerly middle quarter of face.

9. EMERGENCY SPILLWAY: Available No. Needed No.

Height Above Normal Water 3 Ft.

Width Ft. Height Ft. Material .

Condition: 1. Good . 3. Major Repairs .

2. Minor Repairs . 4. Urgent Repairs .

Comments: Abutments of dam are natural ledges rising 15-20 ft. above crest of spill-
way dam - but top of Dike No. 2-8-8-4A, on north side of north ledge out-
cropping is about 3' above crest.

10. WATER LEVEL AT TIME OF INSPECTION: 1/6 Ft. Above X. Below .

Top Dam X F.L. Principal Spillway .

Other There is a earth dike north of ledge abutment at north end of dam about 200
north with its top about 3 to 4 ft. above spillway crest elevation.

Normal Freeboard 15'-20' Ft. to top ledge abutment at either end of dam. See
also Factory Hollow Dike No. 2-8-8-4 - 3' freeboard here.

11. SUMMARY OF DEFICIENCIES NOTED:

Growth (Trees and Brush) on Embankment None Noted.

Animal Burrows and Washouts None Found.

Mortar plaster coat on back side dam cracked with
Damage to Slopes or Top of Dam some cavities - found when dam drawdown.

Cracked or Damaged Masonry See Above.

Evidence of Seepage None Seen.

Evidence of Piping None Seen.

Leaks Yes. Leaks are generally located on south end of dam. Leakage begins when
water raises to within 6' to 7' of crest.

Erosion None.

Trash and/or Debris Impeding Flow No.

Clogged or Blocked Spillway No.

Other Public has free access to crest of dam.

(12.)

OVERALL CONDITION:

1. Safe_____.
2. Minor repairs needed_____.
3. Conditionally safe - major repairs needed X_____.
4. Unsafe_____.
5. Reservoir impoundment no longer exists (explain)
Recommend removal from inspection list_____.

(13.)

REMARKS AND RECOMMENDATIONS: (Fully Explain)

Since our inspection on December 14, 1972, the Town of Amherst, the owner, has done considerable investigation and some remedial work on this dam. They drewdown the pond by tearing out the old timber gates at the upstream ends of the upper sluice and penstock. Then, using a crane and clam shell bucket, the silt deposit over the lower or mud sluice inlet was excavated sufficiently to expose the top of the inlet chimney. The wooden barrier was removed from the top of the chimney and sufficient investigation carried out to determine that the mud sluice on the upstream end is a dressed stone box. While the water was drawdown some repairs, mainly dental type filling of cavities in the upstream face were done. A steel plate with a concrete cover was installed across the penstock opening and the steel penstock tube below the dam was removed. Steel plates with cable attached were placed as temporary gates in the gate guide slots at the upstream ends of both sluiceways.

The Town retained Figue and Bond, Consulting Engineers, to provide engineering services relative to the rehabilitation of the dam. After a preliminary investigation it was decided to refill the pond until a final decision could be arrived at. Most recently core borings have been taken through the crest of the dam but these have not yet been evaluated.

On December 3, 1974, the District II, Dams and Reservoirs Engineer, together with Mr. James Smith, Town Engineer, of Amherst inspected the Factory Hollow Dam. At this time water was overflowing the crest about 3 to 4 inches deep. Some leakage could be observed through the blocked off penstock and through the upper sluice. Also, there was considerable leakage from the masonry joints on the vertical downstream face of the dam. These were particularly prominent in the middle part of the southerly quarter. However, the leakage through the wall did not appear to be as great as during our 1972 inspection. Mr. Smith commented that the leakage appeared to be less than when the

RCS/js/sd

- 5 -

13. REMARKS AND RECOMMENDATIONS: CONTINUED

pond was refilled this spring.

Mr. Smith was able to provide information as to the condition found when the pond was drawdown last winter. This information was used in the preparation of this inspection report and the revised sketches which accompany it.

RCS/sd

INSPECTION REPORT - DAMS AND RESERVOIRS

1. LOCATION:

City/Town Amherst County Hampshire Dam No. 2-8-8-44

Name of Dam Dike for Factory Hollow Pond

Mass. Rect.

Topo Sheet No. 11B Coordinates: N 517,700, E 324,700

Inspected by: H. T. Shumway, On Jan. 22, 1975 Date 12-14-72 Last Inspection

2. OWNER/S: As of Jan. 22, 1975

per: Assessors _____, Reg. of Deeds _____, Prev. Insp. X, Per. Contact _____

1. George A. Cavanaugh, Jr., 64 Mill Street, Amherst, Mass. 413-549-0611
Name St. & No. City/Town State Tel. No.

2. _____
Name St. & No. City/Town State Tel. No.

3. _____
Name St. & No. City/Town State Tel. No.

3. CARETAKER: (if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

Same
Name St. & No. City/Town State Tel. No.

4. DATA:

No. of Pictures Taken None Sketches See description of Dam.
Plans, Where None located

5. DEGREE OF HAZARD: (if dam should fail completely)*

1. Minor _____ 3. Severe X

2. Moderate _____ 4. Disastrous _____

As dike appears to be built on ledge and impounds only the top 3 - 4
Comments: feet of water its failure would not completely drain pond

*This rating may change as land use changes (future development).

⑥ OUTLETS: OUTLET CONTROLS AND DRAWDOWN

No. 1 Location and Type: See Inspection Report for Dam 2-8-8-4.

Controls____, TYPE:_____.

Automatic _____. Manual _____. Operative Yes _____, No _____.

Comments: _____.

No. 2 Location and Type: _____.

Controls _____, Type: _____.

Automatic____. Manual____. Operative Yes____, No____.

Comments: _____

No. 3 Location and Type: _____

Controls _____, Type: _____.

Automatic____. Manual____. Operative Yes____, No____.

Comments: _____

Drawdown present Yes____, No____. Operative Yes____, No____.

Comments: See Inspection Report for Dam 2-9-8-4

(7.) DAM UPSTREAM FACE: Slope 1:1, Depth Water at Dam 6' to 8'.

Material: Turf X. Brush & Trees . Rock fill . Masonry . Wood

Other _____.

Condition: 1. Good x. 3. Major Repairs .

2. Minor Repairs_____. 4. Urgent Repairs_____.

Comments: Well turfed - no brush - 3 trees on old ground near face of dike

8. DAM DOWNSTREAM FACE: Slope 2:1 or less

Material: Turf X . Brush & Trees . Rock Fill . Masonry . Wood

Other _____.

Condition: 1. Good X. 3. Major Repairs .

2. Minor Repairs_____. 4. Urgent Repairs_____.

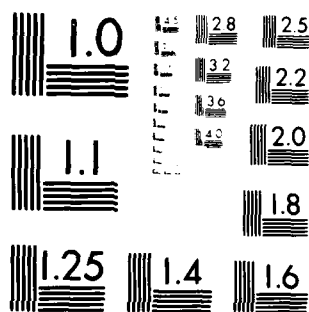
Comments: Dike on top of natural slope of 4:1⁺.

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
FACTORY HOLLOW DAM (M..U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV OCT 80

212

F/G 13/13 NL

[illegible]



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

9. EMERGENCY SPILLWAY: Available X. Needed _____.

Height Above Normal Water: _____ Ft.

Width _____ Ft. Height _____ Ft. Material _____.

Condition: 1. Good _____ 3. Major Repairs _____.

2. Minor Repairs _____ 4. Urgent Repairs _____.

Comments: See Inspection Report on Dam No. 2-8-8-4

10. WATER LEVEL AT TIME OF INSPECTION: 4 Ft. Above _____ Below X _____.

Top Dam _____ F.L. Principal Spillway _____.

Other Top of dike _____.

Normal Freeboard 4 1/2 _____ Ft.

11. SUMMARY OF DEFICIENCIES NOTED:

Growth (Trees and Brush) on Embankment Some trees on natural ground near dike.

Animal Burrows and Washouts None found.

Damage to Slopes or Top of Dam None found.

Cracked or Damaged Masonry N/A.

Evidence of Seepage None found.

Evidence of Piping None found.

Leaks None found.

Erosion None found.

Trash and/or Debris Impeding Flow N/A.

Clogged or Blocked Spillway N/A.

Other _____.

(12.)

OVERALL CONDITION:

1. Safe X.
2. Minor repairs needed _____.
3. Conditionally safe - major repairs needed _____.
4. Unsafe _____.
5. Reservoir impoundment no longer exists (explain)
Recommend removal from inspection list _____.

(13.)

REMARKS AND RECOMMENDATIONS: (Fully Explain)

The grade and alignment of dike appears good. The slopes appear to be well turfed and stable. This is an earthen dike of 4' to 5' in height and 8' to 10' wide on top and 120'±, in length, which closes a low area of natural ground between ledge outcropping of north abutment of Dam No. 2-8-8-4 and high ground to the north. Dike appears safe and well maintained at this time.

RCS/js/vk

GEORGE H. McDONNELL
PHILIP W. SHERIDAN
EDWARD J. BAYON

TIGHE & BOND

CONSULTING ENGINEERS
ENVIRONMENTAL SPECIALISTS

CIVIL, SANITARY AND ELECTRICAL ENGINEERING
INDUSTRIAL WASTES SOLID WASTES
INVESTIGATIONS, REPORTS, PLANS, AND SPECIFICATIONS
SUPERVISION OF CONSTRUCTION AND OPERATION

ASSISTANT CHIEF ENGINEERS

DAVID G. HEALEY
JOHN W. POWERS
GARY R. SWANSON

ASSOCIATES

DENNIS H. BIANCHI
THOMAS C. COUTURE
MICHAEL R. FINN
GERARD L'HEUREUX
EDWARD A. MOE

50 PAYSON AVENUE
EASTHAMPTON, MASSACHUSETTS 01927
TEL. 435-2756/67
435-3399

A-147-00
October 26, 1976

Mr. James A. Smith, Town Engineer
Town Office
Amherst, Massachusetts 01002

Re: Factory Hollow Dam

Dear Sir:

Last week I made an inspection of the above subject dam to determine its general condition now that the upstream and crest concrete surfacing has been completed and water level restored to crest elevation behind the dam.

The upstream face of the dam and the crest have been surfaced with a continuous reinforced concrete slab from the toe area to and across the crest from the left abutment to a point about 60% of the dam length.

The area involved is that portion of the upstream face of the dam where the surface of the masonry was cracked, contained numerous holes and was generally in a deteriorated condition.

The new concrete surface appeared to have been extended continuously across the crest of the dam.

On the day of inspection, Monday October 18th, water was overflowing the shallow crest notch located above the drawdown opening through the dam. About 1-inch of water was overflowing the crest notch.

An examination of the downstream face of the dam showed virtually no seepage of any consequence through the dam masonry. At the top of the dam, downstream face, to the left of the lower drawdown pipe as one faces downstream, water was discharging through a joint in the stone blocks of the dam.

The discharge was at a fairly good velocity but the water appeared clear and free of any sediment or soil particles. In all probability the water may be entering the voids of the dam masonry from underneath the concrete surfacing slab added to the upstream face of the dam. I do not think that the discharge of water as observed is serious. The discharge should be observed from time to time and, if the quantity of discharge appears to increase or if soil or gravel particles are being carried through the dam with the water, the leakage should be investigated further.

Major work still remaining to be done at the dam includes the installation of a proper sluice gate, operator and access bridge as well as erosion control at the toe of the dam to prevent overflowing water from washing out the downstream toe area.

If the toe area is eventually stabilized with mass concrete, discharging water from the leak just described should be carried through the mass concrete in a 4-inch pipe. The pipe could be butted against the stone masonry and sealed in such a manner that the discharging water would be carried through the 4-inch pipe while the erosion control mass concrete is placed.

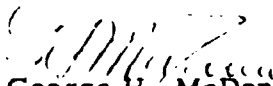
If it is decided to use porous riprap for stabilization, it would not be necessary to provide any special treatment for the leak.

It would be advisable to notify the Division of Waterways of the maintenance and repair work completed to date. It is my understanding that the Division of Waterways may eventually be taken out of the jurisdiction of the Massachusetts Department of Public Works.

If I can be of any further service to you on this or any other engineering matters, please do not hesitate to contact me.

Very truly yours,

TIGHE & BOND


George H. McDonnell, P. E.
Consultant

GHM/gg

INSPECTION REPORT - DAMS AND RESERVOIRS

1. LOCATION:

City/Town Amherst County Hampshire Dam No. 2-8-8-4A

Name of Dam Factory Hollow "Puffer's Pond" Dike
Mass. Rect.

Topo Sheet No. 11 B Coordinates: N 517,700, E 324,700

Inspected by: Harold T. Shumway, On Nov. 17, 1976 Date
Last Inspection 1-22-75

2.

OWNER/S: As of Nov. 17, 1976

per: Assessors _____, Reg. of Deeds _____, Prev. Insp. X, Per. Contact _____

1. George A. Cavanaugh, Jr., 64 Mill St., Amherst, Mass.
Name St. & No. City/Town State Tel. No.

2. _____
Name St. & No. City/Town State Tel. No.

3. _____
Name St. & No. City/Town State Tel. No.

3.

CARETAKER: (if any) e.g. superintendent, plant manager, appointed by
absentee owner, appointed by multi owners.

Same as above.

Name St. & No. City/Town State Tel. No.

4.

DATA:

No. of Pictures Taken None Sketches See description of Dam.
Plans, Where _____

5.

DEGREE OF HAZARD: (if dam should fail completely)*

1. Minor _____ 3. Severe X

2. Moderate _____ 4. Disastrous _____

Failure of dike would not drain pond, but owner's residence and a large
Comments: apartment complex directly below.

*This rating may change as land use changes (future development).

6.

OUTLETS: OUTLET CONTROLS AND DRAWDOWN

No. 1 Location and Type: See inspection report 2-8-8-4.

Controls _____, TYPE: _____.

Automatic _____. Manual _____. Operative Yes _____, No _____.

Comments: _____.

No. 2 Location and Type: _____.

Controls _____, Type: _____.

Automatic _____. Manual _____. Operative Yes _____, No _____.

Comments: _____.

No. 3 Location and Type: _____.

Controls _____, Type: _____.

Automatic _____. Manual _____. Operative Yes _____, No _____.

Comments: _____.

Drawdown present Yes X, No _____. Operative Yes _____, No _____.Comments: See inspection report for Dam No. 2-8-8-4.

7.

DAM UPSTREAM FACE: Slope 1:1, Depth Water at Dam _____.Material: Turf X. Brush & Trees X. Rock fill _____. Masonry _____. Wood _____.

Other _____.

Condition: 1. Good _____. 3. Major Repairs _____.

2. Minor Repairs X. 4. Urgent Repairs _____.Comments: Minor brush growth along waters edge of dike-3 trees on old groundnear face of dike. Some loss of turf cover noted on southerly end of dike.

8.

DAM DOWNSTREAM FACE: Slope 2:1 or less.Material: Turf X. Brush & Trees _____. Rock Fill _____. Masonry _____. Wood _____.

Other _____.

Condition: 1. Good X. 3. Major Repairs _____.

2. Minor Repairs _____. 4. Urgent Repairs _____.

Comments: Downstream slope appears good.

- 3 -

9. EMERGENCY SPILLWAY: Available X. Needed _____.

Height Above Normal Water: _____ Ft.

Width _____ Ft. Height _____ Ft. Material _____.

Condition: 1. Good _____. 3. Major Repairs _____.
2. Minor Repairs _____. 4. Urgent Repairs _____.

Comments: See inspection report for dam No. 2-8-8-4

10. WATER LEVEL AT TIME OF INSPECTION: 3 Ft. Above _____. Below X _____.

Top Dam _____ F.L. Principal Spillway _____.

Other Top of dike.

Normal Freeboard 3' to 4 Ft.

11. SUMMARY OF DEFICIENCIES NOTED:

Growth (Trees and Brush) on Embankment Minor brush growth along water's edge.

Animal Burrows and Washouts None found.

Damage to Slopes or Top of Dam Uneven grade and loss of turf cover noted along top of dike on southerly end.

Cracked or Damaged Masonry N/A

Evidence of Seepage None found.

Evidence of Piping None found.

Leaks None found.

Erosion See damage to slopes above.

Trash and/or Debris Impeding Flow N/A

Clogged or Blocked Spillway N/A

Other _____

⑫.

OVERALL CONDITION:

1. Safe_____.
2. Minor repairs needed_____X_____.
3. Conditionally safe - major repairs needed_____.
4. Unsafe_____.
5. Reservoir impoundment no longer exists (explain)
Recommend removal from inspection list_____.

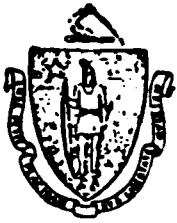
⑬.

REMARKS AND RECOMMENDATIONS: (Fully Explain)

This dike was inspected in conjunction with Dam No. 2-8-8-4. A minor brush growth along water line was noted. Turf cover very sparse along southerly end on top of embankment.

HTS/at

FEB 14 1977



The Commonwealth of Massachusetts FEB 14 1977

EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL QUALITY ENGR.
DIVISION OF WATERWAYS

100 Nashua Street, Boston 02111

Amherst Conservation Commission
Town Hall
Amherst, Ma.

1977
February 10, 1976

Re: Inspection Dam #2-8-8-4
Factory Hollow Dam
"Puffer's Pond"
Amherst, Ma.

Dear Sir:

On November 17, 1976, an Engineer from the Massachusetts Department of Public Works made a visual inspection of the above dam. Our records indicate the owner to be the Town of Amherst. If this information is incorrect, will you please notify this office.

The inspection was made in accordance with the provisions of Chapter 253 of the Massachusetts General Laws as amended (Dams Safety Act). Chapter 706 of the Acts of 1975 transferred the jurisdiction of the so-called "Dams Safety Program" to the Commissioner of the Department of Environmental Quality Engineering.

The results of the inspection indicate that this dam is conditionally safe. The following conditions were noted that require attention:

1. Northerly end of Dam still in need of repairs.
2. Leaks: Four pressure leaks are evident near base of dam just north of 16" drain. Large pressure leak at intake of penstock.

We call these conditions to your attention before they become serious and more expensive to correct. With any correspondence please include the number of the dam as indicated above.

Very truly yours,

John V. Hannon, F.E.
Chief Engineer

At:

cc: Board of Selectmen
District Highway Engr., Dist. 2
District Dams & Reservoir Engr., Dist. 2
File B-51

FACTORY HOLLOW DAM AND DIKE

APPENDIX C

PHOTOGRAPHS

Note: Location and direction of photographs shown on Figure
B-1 in Appendix B.

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE



NO. 1 DOWNSTREAM FACE OF DAM



NO. 2 BRIDGE OVER MILL RIVER DOWNSTREAM OF DAM



NO. 3 TOP OF DAM AND RIGHT ABUTMENT



NO. 4 TOP OF DAM, SPILLWAY AND LEFT ABUTMENT



NO. 5 DOWNSTREAM RIGHT ABUTMENT, SPILLWAY AND
UPPER LEVEL OUTLETS



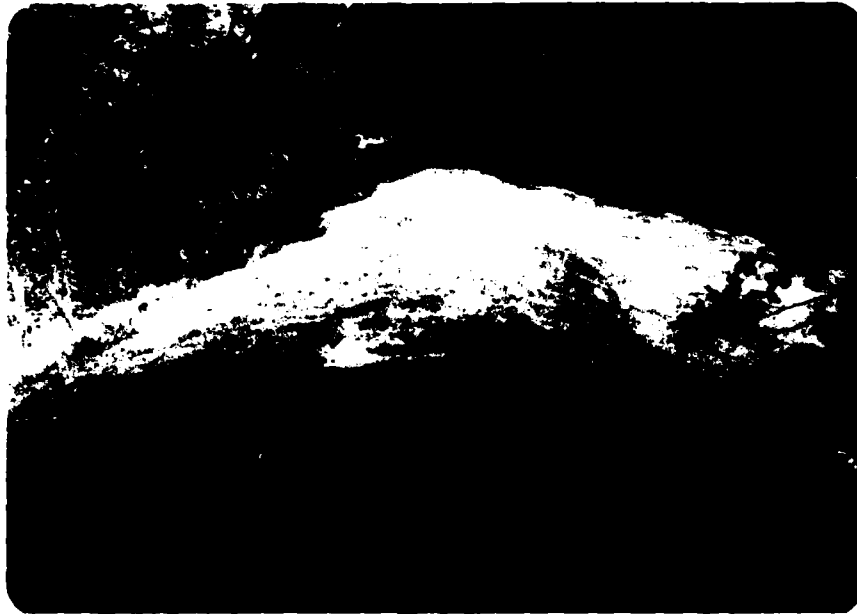
NO. 6 DOWNSTREAM LEFT ABUTMENT AND LOW LEVEL
OUTLET



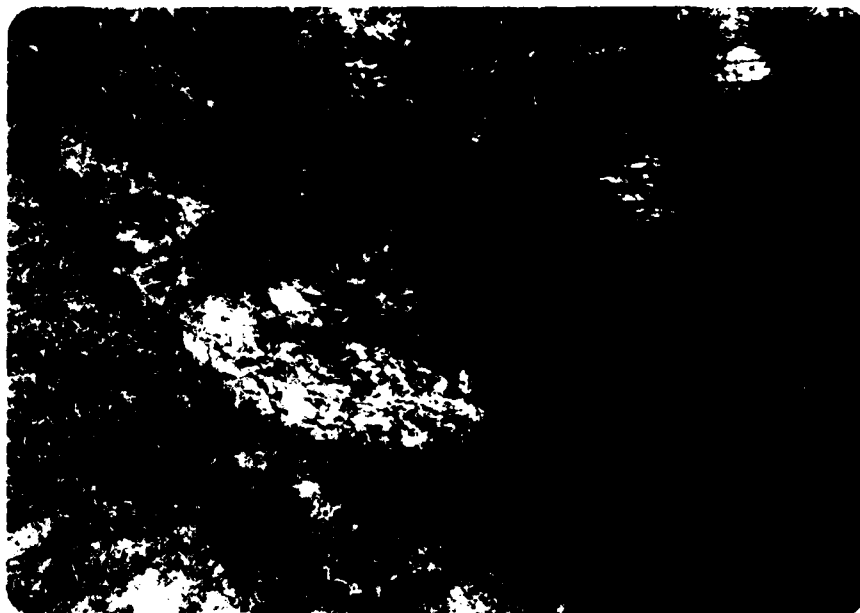
NO. 7 SEEPAGE AROUND PEN STOCK



NO. 8 LOW LEVEL OUTLET AND SEEPAGE AT BASE OF DAM



NO. 9 TOP OF DIKE AND DOWNSTREAM SLOPE FROM
RIGHT ABUTMENT



NO. 10 LOCAL SLOUGHING OF UPSTREAM FACE OF DIKE

APPENDIX D
HYDROLOGIC AND HYDRAULIC
COMPUTATIONS

	<u>Page</u>
Figure D-1, Drainage Area Map	D-1
Hydrologic and Hydraulic Computations	D-2

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE

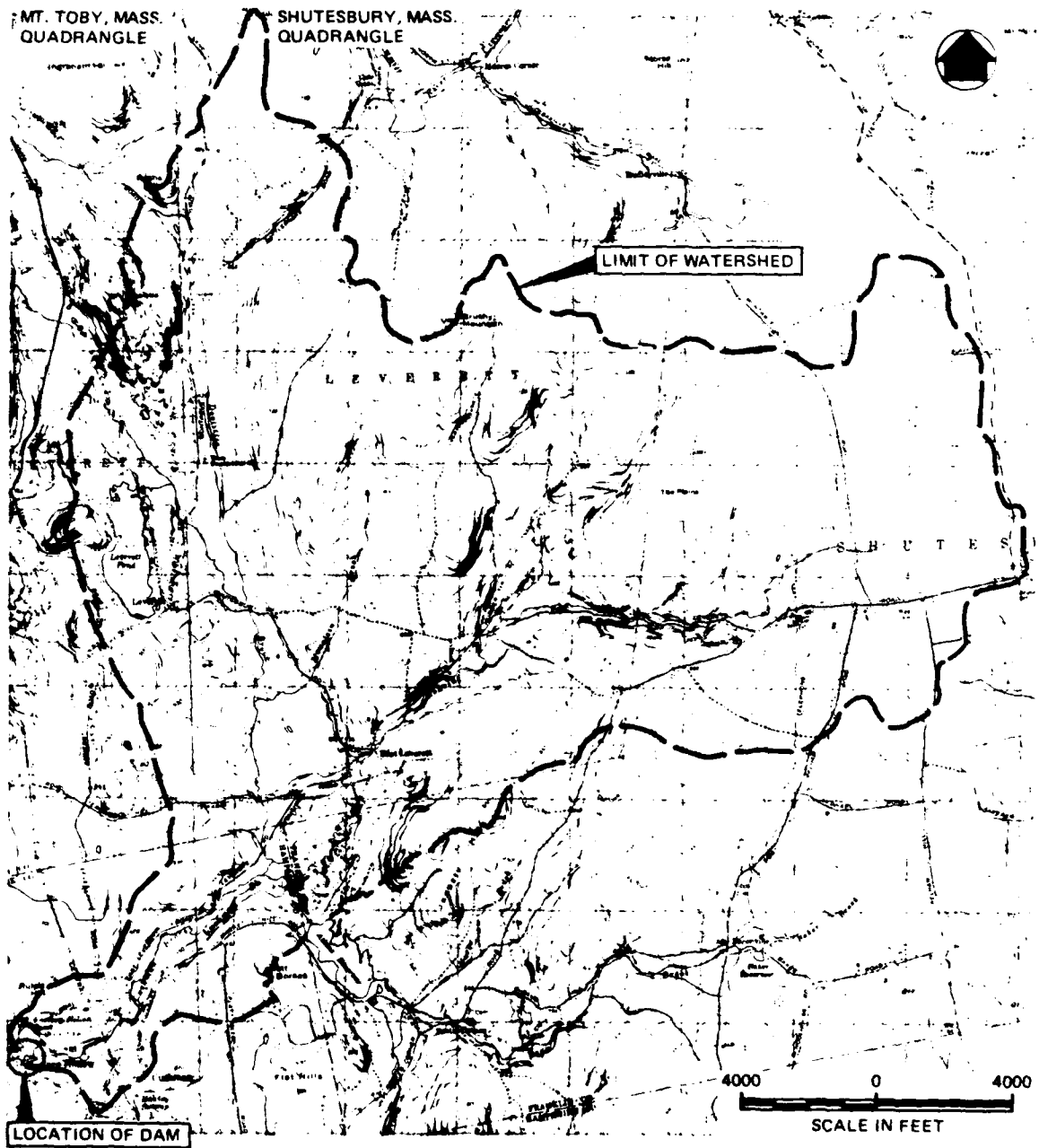


FIG. D-1 DRAINAGE AREA MAP

FACTORY HOLLOW POND DAM

I. TEST FLOOD, STORAGE & STORAGE FUNCTION

A. The total drainage area is 15.0 sq mi

B. Area of ponds : 0.14 sq mi
 " " swamps : 0.42 sq mi
 total : 0.56 sq mi

% of ponds & swamps $0.56 / 15.0 = 3.73\%$

C. Average slope of watershed

Roaring Brook } $\frac{1300 - 223}{49700} = 2.17\%$
 Cushman Brook }

Doolittle Brook $\frac{921 - 223}{42000} = 1.66\%$

Weighted, average slope is 1.97%

D. Using the USCE curves for peak flow rates along with the above information, the peak flow rate was established between rolling and flat & coastal. The value used was 1200 cfs / sq mi

size class: small
 hazard potential: high } Test flood is 1/2 PMF

E. Test flood inflow $\frac{1}{2} (1200 \text{ cfs/sq mi}) (15.0 \text{ sq mi}) = 9000 \text{ cfs}$

F. Pond Storage: The pond area is 8 acres (0.013 sq mi) at elev 223.0. Based on a constant area, storage increases at 8 ac-ft per foot of depth increase

G. The low point on the main spillway crest is at Elev 223.0

H. The storage function is based on $Q_{out} = Q_{in} [1 - \frac{S_{out}}{R}]$

S_{out} = Storage volume in reservoir related to final Q_{out} in terms of inches of rain over the drainage area.

Project USCE DAM INSP VW 95 Acct No J 6928 Page 2 of 11
 Subject HAMPSHIRE Co, MA Comptd By M NOWAK Date 9-15-80
 Detail FACTORY HOLLOW DAM Ckd By LEB Date 10/7/80

$$S(\text{inches}) = 12 D (.013 / 15.5) = .01 D; R = 6 \text{ hr. rain of storm}$$

D = Storage depth in ft above spillway crest in reservoir.

STORAGE FUNCTION ($\frac{1}{2}$ PMF)

$$F(\frac{1}{2} \text{ PMF}) = 9000 - 947 S = 9000 - 9.47 D$$

II. DISCHARGE RATINGS

The spillway, which is the entire crest of the dam, is a broad crested weir.

- ① at EL 223, length is 22'
 ② at EL 223.2 - 223.4 " " 60.5' use EL 223.3
 ③ at EL 224.5 - 224.7 " " 27' use EL 224.6
 ④ at EL 224.7 " " 13' (exposed ledge)

$$Q = 3.0 L H^{1.5} \text{ (SPILLWAY) (cfs)}$$

$$Q = 2.55 L H^{1.5} \text{ (LEDGE) (cfs)}$$

METCALF & EDDY, ENGINEERS

RES. EL.	223.0	223.3	223.5	224.0	224.5	224.6	225.0	226.0	228.0	228.4	230.0	231.0	232.0
H ₁	0	.3	.5	1.0	1.5	1.6	2.0	3.0	5.0	5.4	7.0	8.0	9.0
H ₂		0	.2	.7	1.2	1.3	1.7	2.7	4.7	5.1	6.7	7.7	8.7
H ₃						0	.4	1.4	3.4	3.8	5.4	6.4	7.4
H ₄							.3	1.3	2.3	2.7	4.3	5.3	6.3

Q ₁	0	11	23	66	121	134	187	343	738	828	1222	1493	1782
Q ₂		0	16	106	239	269	402	805	1849	2090	3148	3878	4658
Q ₃						0	20	134	508	600	1016	1311	1631
Q ₄							5	49	115	147	296	404	524

Q _{TOTAL}	0	10	40	170	360	400	610	1330	3210	3670	5680	7000	8600
--------------------	---	----	----	-----	-----	-----	-----	------	------	------	------	------	------

There are 2 dikes at the right and left hand side of the dam

⑤ right dike low point elev @ 230.0 length 140'

⑥ The left lowpoint ends at State St. Discharge over the left dike will include the discharge down State Street.

Project USCE DAM INSP VW 98 Acct No 6928 Page 3 of 11
 Subject HAMPSHIRE CO. MA Comptd By M. JAWAK Date 9-15-80
 Detail FACTORY FLOW DAM Ch'd By LEB Date 10/7/80

- left low point elev @ ± 228.4 length 60'
 (includes
 Stone Structure)
 @ ± 229.2 length 30'

RES ELEV	228.4	228.8	229.2	230.0	230.5	231.0	232.0
H ₁				0	.5	1.0	2.0
L ₁	0	33	66	102	102	102	102
H ₀	0	.2	.4	1.2	1.7	2.2	3.2

+ average flow
 used for reservoir
 surge simulation
 SEE -

using $Q = 2.55 \text{ LH}^{1.5} \text{ (CFS)}$

Q_1				0	126	387	1010
Q_0	0	8	43	342	574	849	1489

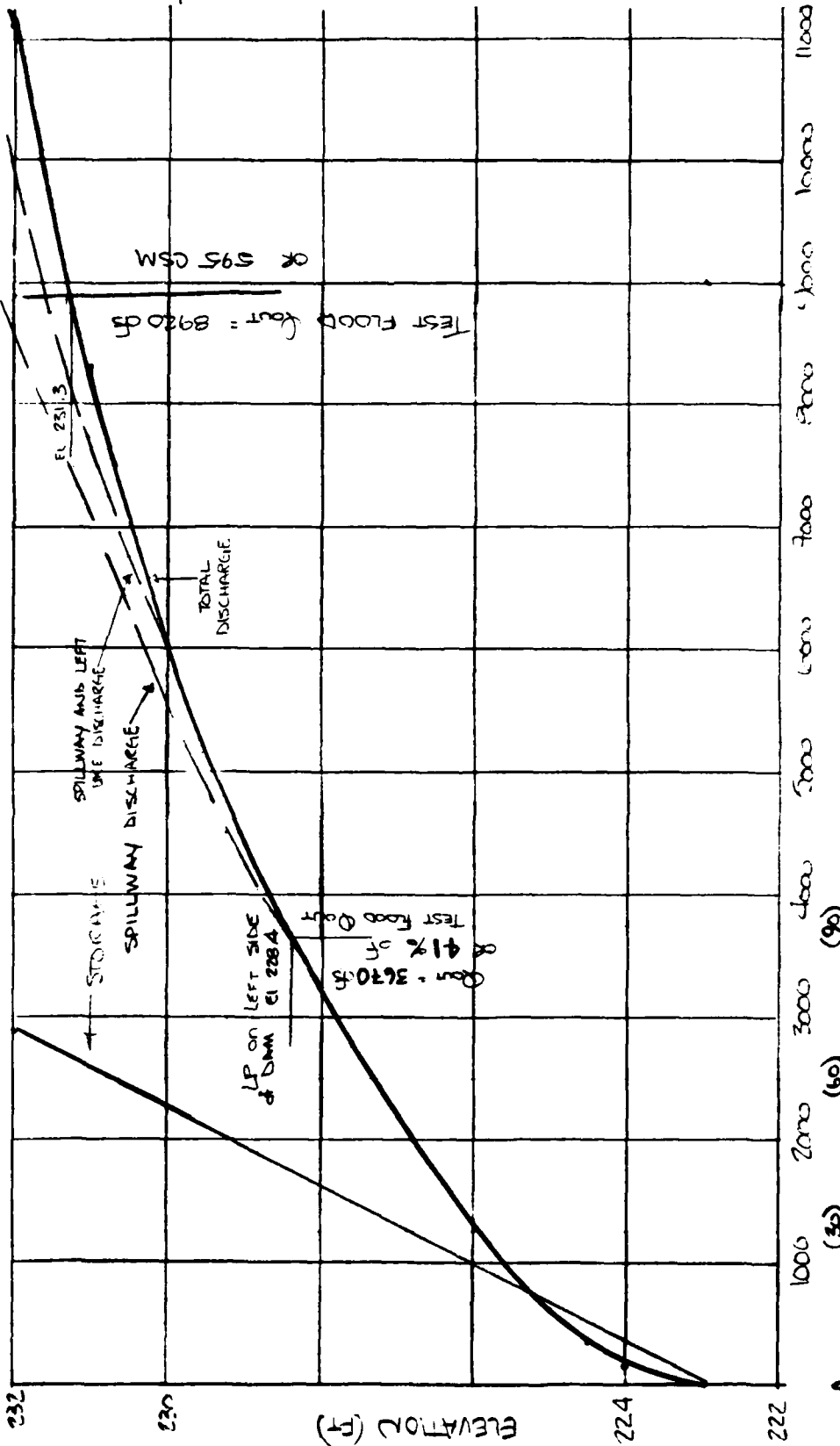
Q_2	0	10	40	340	720	1210	2500
Q_1	3670			6020		9330	11100

METCALF & EDDY, ENGINEERS

NONREPRODUCIBLE GRID FORM 145

Project USLE P-2 DAM WSP VN 93 Acct No 6928 Page 4 of 11
 Subject HANDSHAKE ON MISS Comptd By M NOWAK Date 8-15-80
 Detail FACTORY FOLLOW DAM & CE Ckd By LEB Date 10/7/80

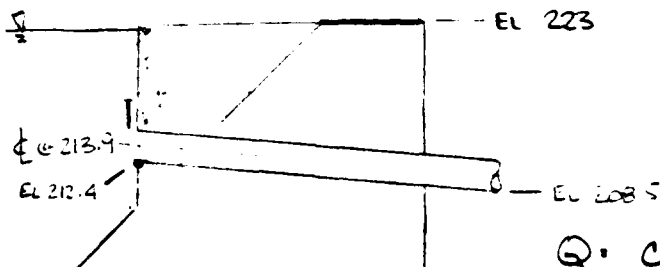
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DISCHARGE (CFS)
 (STORAGE, AC-FT)

Project USCE DAM INSP V-W 9B Acct No J 6928 Page 5 of 11
 Subject HAMPSHIRE Co. MA Comptd By M. NOWAK Date 9-15-80
 Detail FACTORY HOLLOW DAM Chk d By LEB Date 10/7/80

III LOW LEVEL OUTLET: There are two upper level outlets, a penstock and a sluiceway. Neither of these are operable in the event of a sudden storm. If, however, the penstock could be opened, then the time to lower the reservoir one foot could be calculated. (The elevations used here are based on as built drawings from the town of Amherst, Engineering Department)



To lower reservoir from EL. 223' to 222', one head is

$$\frac{9.1 + 8.1}{2} = 8.6'$$

$$Q = CA \sqrt{2gH}$$

$$Q = 0.6 (\pi)(1.5)^2 \sqrt{2(32.2)8.6'}$$

$$Q = 99.8 \text{ cfs} \Rightarrow 198 \text{ AC-Ft/day}$$

Time to drain one foot:

$$\frac{8 \text{ AC-Ft}}{198 \text{ AC-Ft/day}} \times 24 \text{ hr/day} = .97 \text{ hrs (58 min)}$$

Project USCE DAM INSP VN 9B Acct No J 6928 Page 6 of 11
 Subject HAMPSHIRE CO., MA Comptd By M. NOWAK Date 9-15-80
 Detail FACTORY HOLLOW DAM & DIKE Chk'd By LFB Date 1/12/81
 Rev. 1-E-81

II DAM FAILURE

- ① Width of dam subject to failure is 50 ft.
 Consider top flood at El 231.3

Res Elev. @ Peak discharge El. 231.3
 Toe Elev. 142.2
 Yo 39.1 ft

The peak failure flow is calculated as

$$Q = 1.49 A Y^{5/3} S^{1/2} = 1.49 (50)(39.1)^{5/3} (0.0001)^{1/2} = 20,540 \text{ cfs}$$

Storage volume released

$$\begin{aligned} \text{above spillway } (50)(9.1) &= 455 \text{ cu ft} \\ \text{below spillway } \frac{1}{3}(50)(39.1) &= 651.7 \text{ cu ft} \\ \hline &1106.7 \text{ cu ft} \end{aligned}$$

Ingoing flow from upstream = 20,540 cfs
 $Q = 1.49 A Y^{5/3} S^{1/2} = 4900 \text{ cfs}$

The total failure discharge is then 20,540 + 4900 cfs = 25,440 cfs.

Based on channel hydraulics, Section 2.4, the flow will increase the elevation in the downstream channel from El 208.0 to El 210.3, a 2.3 foot increase in depth in the culvert, this is an increase in water depth from 16.3 feet to 18.6 feet.

- ② Consider top of low flood area east of left abutment at El 228.0. Width subject to failure is 50 ft.

Res Elev. El. 228.0
 Toe Elev. 142.2
 Yo 36.2 feet

The failure flow at this elevation is

$$Q = 1.49 A Y^{5/3} S^{1/2} = 1.49 (50)(36.2)^{5/3} (0.0001)^{1/2} = 18,300 \text{ cfs}$$

Storage volume released, above spillway $(50)(5.8) = 290 \text{ cu ft}$
 below spillway $\frac{1}{3}(50)(36.2) = 603.3 \text{ cu ft}$
 $\hline 893.3 \text{ cu ft}$

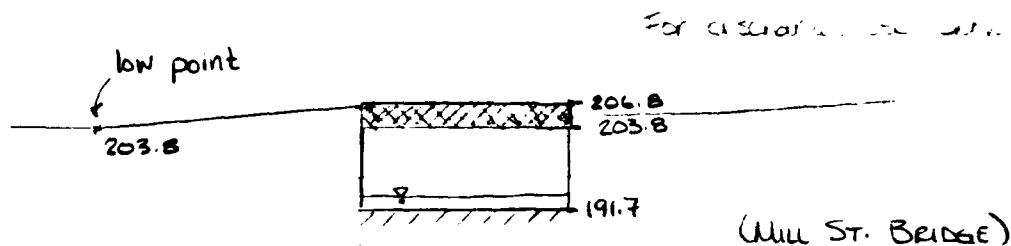
Ingoing flow over spillway $Q = 1.49 A Y^{5/3} S^{1/2} = 2400 \text{ cfs}$

The total failure discharge is 2400 + 18,300 = 20,700 cfs

This will increase the water depth in the downstream channel from El 203.5 to El 204.8, a 1.3 foot increase in depth.

Project USCE DAM INSP P-2 VV 98 Acct No 622 Page 3 of 11
 Subject BRIDGE NO. 11 Comptd By H. D. ... Date 10-17-80
 Detail BRIDGE SECTION DAM Ckd By LEB Date 10/7/80

II CHANNEL HYDRAULICS - CONTROL STRUCTURE IS THE ...



ELEV	W	L	H	Q
204.0	10.0	1.0	1.0	0
205.0	12.0	0.27	1.0	0
206.0	14.0	0.33	20	000
207.0	16.0	0.50	20	1200
208.0	18.0	0.60	62	1200
209.0	20.0	0.85	100	3600
210.0	22.0	1.00	100	1000
211.0	24.0	1.25	100	1000
212.0	26.0	1.5	100	1000
210.0	18.3	1.6	192	5760

At ... low point to the right of the Mill St. bridge at $EI \pm 203.8$.

... 1.5

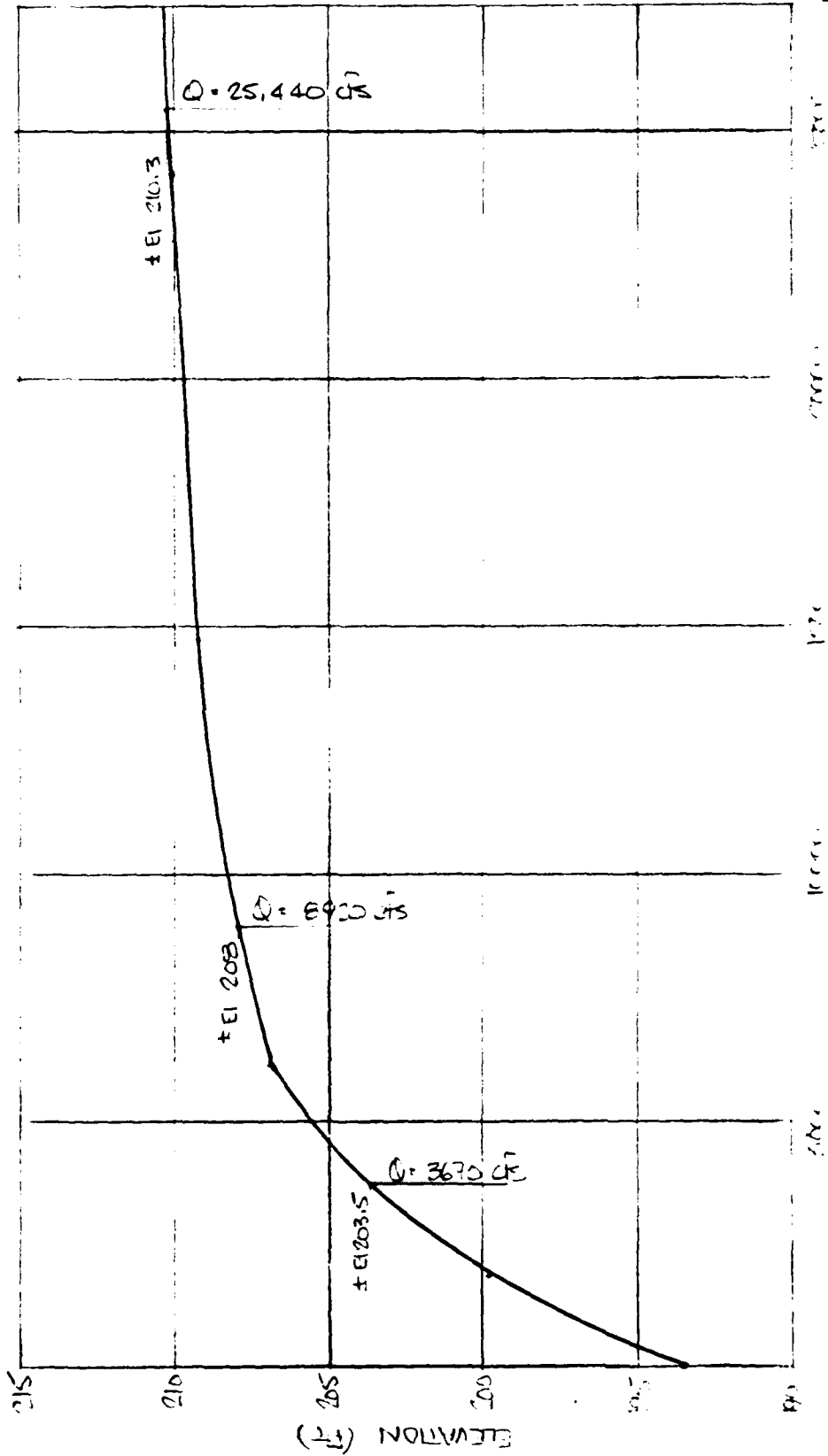
ELEV	W	L	H	Q
204.0	10.0	1.0	1.0	0
205.0	12.0	1.2	1.0	0
206.0	14.0	1.7	1700	
207.0	16.0	2.2	4200	
209.0	20.0	3.0	± 9300	
210.0	22.0	4.0	± 18360	

Project USE OF NEW PE 1 CS Acct No. 5-25 Page 5 of 5
 Subject HAMPSHIRE CO. MA Comptd By H. N. N. N. Date 1/12/80
 Detail FACTORY FOLIO 1/1 Ckd By LEB

100-8-81

METCALF & EDDY, ENGINEERS

CHANNEL HYDRAULICS, cont
 at downstream bridge



Project USC&E DAM INSP V-W-98 Acct No J 692B Page 9 of 11
 Subject HAMPSHIRE Co., MA Comptd By M. Nowak Date 9-15-80
 Detail FACTORY HOLLOW DIKE Ckd By LEB Date 10/7/80

VI FAILURE OF RIGHT DIKE

Width of dike subject to failure is 140'

$$W_0 = 40\% (140) = 56 \text{ ft}$$

Elev of low point on left side E_L 230.0

Elev of toe of dike E_T 227.0

$$Y_0 = 3.0$$

The peak failure flow is calculated as

$$Q = 1.68 W_0 Y_0^{1.5}$$

$$= 1.68 (56) (3.0)^{1.5} = 490 \text{ cfs}$$

Storage volume released:

$$\text{below dike} \quad 3 (80) = 24 \text{ ft}^3$$

- Assume that failure occurs at low point of dike crest, E_L 230.0

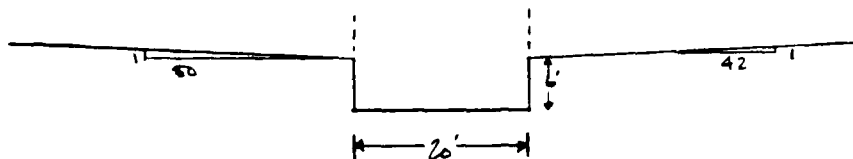
METCALF & EDDY, ENGINEERS

NONREPRODUCIBLE GRID FORM 145

VII FLOOD PLAIN DISCHARGE

TYPICAL DOWNSTREAM CHANNEL SECTION

$$Q = Q(\text{channel}) + Q(\text{floodplain})$$



$$\text{Channel Slope} = \frac{200 - 170}{3500} = 8.57 \times 10^{-3}$$

$$Q_{\text{channel}} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$$= \frac{1.49}{.025} (20y) \left(\frac{20y}{20+2y} \right)^{2/3} (8.57 \times 10^{-3})^{1/2}$$

$$= 110.4 y \left(\frac{20y}{20+2y} \right)^{2/3}$$

$$Q_{\text{floodplain}} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

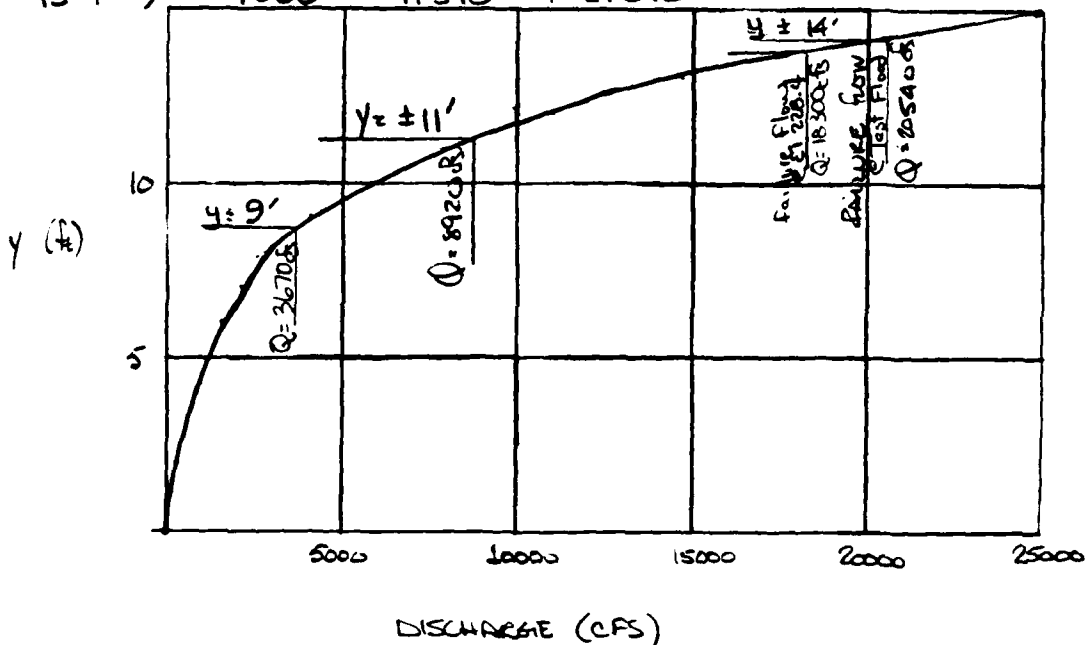
$$= \frac{1.49}{.08} (46(y-6)^2) \left(\frac{1}{2}(y-6) \right)^{2/3} (8.57 \times 10^{-3})^{1/2}$$

$$= 49.97 (y-6)^{8/3}$$

- NOTE THAT FLOOD PLAIN DISCHARGE DOES NOT BEGIN UNTIL WATER SURFACE ELEVATION IS ABOVE $y=6$.

Project USCE DAM INSP VW 9B Acct No 692B Page 11 of 11
 Subject HAMPSHIRE CO., MA Comptd By M. NOWAK Date 10-8-80
 Detail FACTORY HOLLOW DAM, DIKE Ch'd By LEB Date 10/8/80

Y	Y-6	Q _{channel}	Q _{Floodplain}	Q _{TOTAL} (cfs)
2		310		310
4		890		890
6	0	1600	0	1600
7	1	2070	50	2120
8	2	2580	320	2900
9	3	3140	940	4080
10	4	3750	2010	5760
11	5	4390	3650	8040
12	6	5080	5940	11020
13	7	5800	8960	14760
14	8	6560	12790	19350
15	9	7360	17510	24870



FOR FAILURE FLOW AT TEST FLOOD:

FAILURE FLOW IS $\pm 14'$ DEEP FROM BASE OF CHANNEL
 FAILURE FLOW IS $\pm 8'$ DEEP IN FLOODPLAIN

THIS OCCURS AFTER A FLOW WITH $\pm 11'$ DEPTH.
 (5 FT DEEP IN THE FLOODPLAIN)

FOR FAILURE FLOW AT EL 228.4:

FLOW IS $\pm 14'$ DEEP FROM BASE OF CHANNEL
 FLOW IS $\pm 8'$ DEEP IN FLOODPLAIN

THIS OCCURS AFTER A FLOW WITH $\pm 9'$ DEPTH (3 FT IN THE FLOODPLAIN)

APPENDIX E

INFORMATION AS CONTAINED IN THE
NATIONAL INVENTORY OF DAMS

FACTORY HOLLOW DAM
FACTORY HOLLOW DIKE



INVENTORY OF DAMS IN THE UNITED STATES

STATE	DIVISION	COUNTY	CITY	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE
MA	63	WED	1	FACTORY HOLLOW DAM	42° 24.9'	72° 31.2'	0000980

POPULAR NAME	NAME OF IMPROVEMENT
	FACTORY HOLLOW POND

REGION	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	WILL RIVER	NORTH AMPERST	00	30150

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STAGE HEIGHT (FEET)	STAGE LENGTH (FEET)	STAGE WIDTH (FEET)	STAGE AREA (ACRES)	STAGE VOLUME (CU YD)	STAGE WEIGHT (TONS)	STAGE MATERIAL	STAGE CONDITION	STAGE REMARKS
DT	1895	RD	33	31	147	80					

REMARKS
21-CUT STONE MASONRY 23-WATER FLOW SAND + GRAVEL PLANT

D/S	SPILLWAY	MAXIMUM DISCHARGE (CU FT)	VOLUME OF DAM (CU YD)	POWER CAPACITY (KW)	INSTALLED PHOTOGRAPHIC EQUIPMENT	NAVIGATION LOCKS	STAGE LENGTH (FEET)	STAGE WIDTH (FEET)	STAGE AREA (ACRES)	STAGE VOLUME (CU YD)	STAGE WEIGHT (TONS)	STAGE MATERIAL	STAGE CONDITION	STAGE REMARKS
1	110	110	7543	1200										

OWNER	ENGINEERING BY	CONSTRUCTION BY
TOWN OF AMPERST	UNKNOWN	UNKNOWN

DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	MA DEGE	MA DEGE

INSPECTION BY	INSPECTION DATE	INSPECTION DAY	INSPECTION MONTH	INSPECTION YEAR	AUTHORITY FOR INSPECTION
METCALF & EDDY, INC.	1941	05	00	PL 02-307	

REMARKS

1ST JAN FED M DIV/FED SCS A VE-DATE

INVENTORY OF DAMS IN THE UNITED STATES

IDENTITY NUMBER	STATE	COUNTY	CORNER	DATE	COUNTY	DATE	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY MO YR
507	ED	WA	DIS	01			FACTORY HOLLOW DIKE	4225.0	7231.1	00000000

POPULAR NAME	NAME OF IMPONDMENT
	FACTORY HOLLOW POND

REGION	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01 08	MILL RIVER-OFFSTREAM	NORTH AMHERST	00	30350

TYPE OF DAM	YEAR COMPLETED	PURPOSES	HYDRAULIC HEAD (FT)	IMPONDING CAPACITIES (ACR-FEET)
RE	1895	PO	3	134

REMARKS
23-WATER FOR SAND & GRAVEL PLANT

DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	MA DESE	MA DELE

OWNER	ENGINEERING BY	CONSTRUCTION BY
GEORGE A. CAVANAUGH, JR	UNKNOWN	UNKNOWN

INSPECTION BY	INSPECTION DATE DAY MO YR	AUTHORITY FOR INSPECTION
WETCALF & EDDY, INC.	1980	PL 02-357

REMARKS

LIST OWN RECORD PROVIDED SCS A 10/4/64

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